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VOL. LXXXVI. MAY 28, 1920. No. 2,218.

ELECTRICAL REVIEW.

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FOREIGN CAPITAL IN GERMANY.

As it is asserted to be difficult to raise fresh capital in Germany, the Germans seem to be inclined to welcome the investment of foreign capital in their industrial undertakings, provided that their national character is maintained and adequate safeguards are adopted to ensure the continuance of a majority of the votes in Teutonic hands—as, for instance, by endowing specified blocks of shares with manifold voting powers or the creation of preference shares for this purpose. In the case of the impending issue of shares by the A.E.G., of Berlin, the amount of 25,000,000 marks has been taken over by an American group at a price which would probably not exceed 1,500,000 marks in normal times, and further transactions are said to be in prospect. At the recent extraordinary general meeting of the A.E.G., the names of the American purchasers were not mentioned, but an American copper and banking group (Guggenheim-Kuhn-Loeb group) are stated to be the buyers. In this connection a French contemporary, apparently anxious to ascertain whether the General Electric Co. of the United States was a party to the operation, has received a cable from New York in the negative. Naturally, in view of recent international developments in the electrical industry, the French were highly desirous of being satisfied on this point, the denial in question having been given, it is said, by the General Electric Co. itself.

Herr Karl F. von Siemens, addressing the shareholders at the recent meeting of the Siemens & Halske Co., when it was decided to increase the share capital from 63 to 126 millions of marks and to confer 30-fold voting rights on the 9,500 shares held by the Siemens family, is reported to have stated that it was necessary to interest foreign capitalists in German industry, and the electrical industry, in particular, had still many duties to perform in connection with the scarcity of coal. It was, however, only possible to prevent foreign control by means of preference shares having a dominating voting power. Coming to consider the question of current business, the chairman remarked that definite predictions could not be made; prices and wages changed day by day; at the moment new wages demands had been put forward which exceeded by far those made previously. But an assured peace was desirable, as the exchange was more favourable to the Germans, and would probably steadily improve to the point of intersection of the internal and external purchasing power of their money if they correctly took cognisance of the present period and supported the improving movement by increased production, that is, by higher efficiency. As a consequence, everything should be avoided which would further depreciate the internal purchasing power of money. When they had reached the point of intersection, difficulties in exports would take place, and already the inland prices of electrical engineering products exceeded the world's market prices. The speaker blamed the rise in the prices of iron and steel as being the principal cause which had led to this effect. The requirements for electrical manufactures throughout the world would continue for a long time forward, but the demand had fallen off owing to the high prices resulting from reduced production in general.

Imperial Telegraphs.

So much has already been said in the columns of the public Press, including our own, and so many resolutions have been passed by representative trade and commercial bodies the world over on the subject of providing an up-to-date and efficient Imperial Telegraphic system, that it may seem almost unnecessary to revert to the subject at this date. The policy of our Government in the past has been to appoint Imperial Departmental Committees and Sub-Committees to make a study of the existing conditions and recommendations for their betterment. Their reports are shelved and possibly forgotten as each new Government Chief is promoted to another field of activities, and it is left to men who have the interests of the Empire at heart, the Press and others, to keep interest in the subject alive, and to remind their successors in office of the nation's desires.

For the maintenance of an Empire like ours, it will be agreed that two things are necessary and of paramount importance, viz. :—Steamship and telegraphic facilities. Without these the guarding of our enormous interests and the proper expansion of the productive capacity of our world-wide colonial possessions is rendered practically impossible. The lack of these facilities makes trade and other relations between the Mother Country and her children most difficult, and profitable transactions are diverted to foreign countries and make our peoples across the seas to a large extent economically dependent on them. For strategic reasons alone the call for world-wide and all-red Imperial communications is so strong and well known that the necessity for emphasising their urgency should not exist, but so many important problems have to be faced by our legislators at the present time that the policy of making the Empire telegraphically self-contained may be permitted to remain in abeyance, and for this reason we again call attention to it. The need for prompt action is imperative in view of our late experiences, and for the purpose of maintaining the Imperial spirit which so largely assisted us to victory.

At one time the controlling centre of telegraphs was undoubtedly London, but changes occurred as other countries adopted a national policy, and laid their own cables and erected their own high-power wireless stations, freeing themselves to that extent from dependence on British-owned lines, and steps in that direction are still being taken. It is, therefore, essential that no weakening of our existing network or failure to strengthen and expand it be permitted. Nor should the control of our lines be permitted to pass into foreign hands. Unfortunately, British Atlantic and West Indian cable companies have been allowed to pass under the ownership and management of American companies, and while the United States is a friendly nation, yet with the expansion of her diplomatic and trade interests, political complications may very well arise whereby such ownership may injuriously affect our interests. The lessons of the Spanish-American War, when the telegraphic correspondence of all British West Indian Islands, except Jamaica, was censored and delayed by the American authorities, who controlled the Key West cable route, should not be forgotten. All German cables were cut on the declaration of the European war, and had it not been for her high-power wireless stations, Germany would have been completely isolated. The United States has established a large number of these stations, and is rapidly building more, and eventually communication by wireless will be available to all European countries, South America, &c. Other countries are also going ahead in this direction. High-power wireless stations are as essential to a country as ships and aeroplanes, and our legislators should lose no time in supplying the necessities of our Empire in the way of cables and wireless stations. It will not need much investigation or study to decide what shall be done, but we hold the opinion very firmly that much has been left undone in the past, and that leeway has to be made up, and that rapidly.

The Beama Dinner.

The leading feature of the proceedings at the dinner of the B.E.A.M.A., last week, was the optimism of Sir John Snell, who made on that occasion, we believe, his first public speech since his appointment as Chief Commissioner. As a result of—or, as a later speaker implied, in spite of—the attentions of no fewer than seven Departmental Committees since 1916, Sir John said, the Electricity Supply Act had been passed—"the great charter of electricity"—and the electrical industries were on the brink of an era of unimagined prosperity. We earnestly hope that his view is correct; every indication certainly points in that direction, and, as has happened before, whether other industries thrive or languish, the electrical industry is inherently certain to develop. The Utopia is placed by Sir John at five to ten years hence; in the meantime, the Commissioners are struggling with the accumulated arrears of five years, and appeal for the patience and forbearance of the industry. We are sure that they have the sincere sympathy of all electrical men, and will do their utmost to get the machine into full operation. Apart from the routine duties of various other departments and bodies which have fallen upon their shoulders, we venture to urge them to settle the broad principles as quickly as possible; in particular, we would again draw their attention to the case of the small isolated stations, and the urgent need for these "to know where they stand," so that they can at once get on with the extensions that are urgently called for. The revision of the various codes of regulations is also a matter of most pressing importance, particularly in respect of the prehistoric and obsolete regulations for overhead mains, on which a committee has been sitting for some 18 months, so that the ground must have been pretty well covered by now. Sharing out the country into districts is a matter of less urgency than the settlement of these questions, and if completely satisfactory solutions to them cannot be given at the moment, let us have the best approximation to them that can be given *now*.

The Station Men.

At the dinner above-mentioned, Mr. James Swinburne, who, unfortunately, is too seldom seen and heard at electrical gatherings nowadays, pleaded the cause of the salaried men with an earnestness and sympathy which commanded attention. In view of the commotion set up recently by an advertisement in our pages, which placed a technical officer on a pecuniary par with a fitter, and Mr. Swinburne's remarks, the arrival of a batch of papers from the Electrical Power Engineers' Association this week, embodying particulars regarding the National Joint Board which is dealing with the case of the station men, and the schedules of wages agreed upon, is very timely. The Board will play the part of a Whitley Council for the station technical and clerical staffs, which are otherwise unprovided for in this respect, having been omitted from that scheme by an extraordinary oversight. As we pointed out recently, it is incumbent upon all electricity supply authorities to accept the decisions of the National and District Joint Boards under this scheme; they cannot expect their staffs to do so if they themselves do not. Whilst writing, we have received particulars of a dispute between Wimbledon Corporation and the National Joint Board, in which the Corporation turned down the recommendation of its own Electricity Committee that an award by the Board of an increase of salary of £30 per annum, from January 1st, 1920, should be adopted.

As we have already pointed out, the workers are not going to play at "heads I win, tails you lose," to please the employers. Loyal compliance with the decisions of the Joint Boards is essential to industrial harmony. The electrical staff of the Corporation threaten to cease work on Monday next; the Executive Council of the E.P.E.A. will support them, unless the decision of the Corporation is reversed, and who will blame them? Certainly we shall not. We hope, however, that wiser councils will prevail, and that peaceful methods will be found to settle the dispute, in which the Corporation of Wimbledon is in an utterly untenable position.

A STUDY IN LOAD FACTORS.

Based on an Experiment carried out by the Glasgow Corporation.

By COUNCILLOR DENNY, Member of Glasgow Town Council.

In August-September, 1918, Glasgow Corporation Electricity Department fitted up two tenement dwelling-houses with electrical apparatus for all domestic purposes. Ammeters were put in circuit in each case for record-keeping purposes. The rate of charge was on the basis of 4½d. per B.O.T. unit for 70 units, and ¾d. per unit for all further units consumed. In the one case the consumption for a year amounted to 10,052 units, and the amount of the electricity bill for the year was £32. In the second case, the consumption for the same period was 10,981 units, and the bill £35.

In the two houses in question no coal or gas was used for any purpose during the period of the experiment. It is estimated that had coal and gas been used for the purposes covered by the electrical energy consumed, the cost would have been £16. The houses in question comprised two rooms, kitchen and bathroom in each case. In one house the equipment consisted of :—One 3-KW. oven with hot-plate on top; one 2-pint kettle; one 1-KW. immersion heater; one smoothing iron, 2-ampere; two 3-KW. radiators; one 1-KW. radiator; one 1·5-KW. Belling fire. In the other house the apparatus consisted of :—Cooker; two hot-plates; one oven with top grill; one 2-pint kettle; three radiators; one smoothing iron.

Having established the fact by experiment that the use of electricity is entirely practicable for all domestic purposes, and knowing that electricity so used has many advantages from the point of view of health and convenience, it is

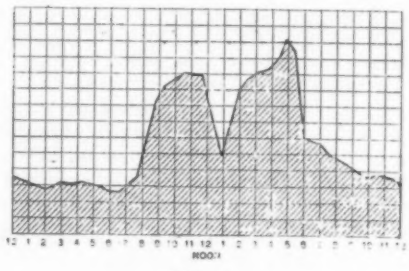


FIG. 1.

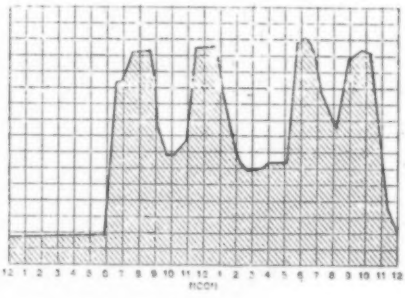


FIG. 2.

obviously a matter of urgent public concern to devise ways and means whereby electricity can be made available for all domestic purposes.

The first consideration is cost. The difference between gas and coal and electricity must be substantially reduced. There are various suggestions forthcoming as to how this may be managed. In the first place, electricity supply concerns, whether municipally or company owned, need to be brought to see the possibilities of the domestic load in the improvement of load factor. We hope to show that it will pay the electrical undertakings to take a liberal view of the domestic consumer, and to cater for him in such a way as to lead him to use electricity for all purposes in the home.

Electricity supply from the load factor point of view may be said to have had three phases. At first it was thought that electricity would always be mainly used for lighting, and all the early legislation relative to electricity supply referred to lighting. The early Acts were all Electric Lighting Acts. At that time the lighting load represented the major portion of the total output, and the power load was a matter of minor concern. The development of the electric motor has changed all this, and electricity supply is now in the second phase. The power load is at present the dominating factor in electricity supply, and lighting is comparatively negligible. But a third phase is now appearing: the domestic load is gradually being recognised as a serious competitor to the power load, and it has attractions to the supply undertaking which even the power load does not possess. The great advance in the manufacture of domestic appliances during the last few years has turned the scale in favour of the domestic load being better distributed and bigger than the power load. The experiment recently carried out by the electricity department of the Glasgow Corporation, already mentioned, has given conclusive confirmation of this important fact. In one house, the load extended over the full 24 hours, while in the other it extended over 15 hours of the 24, whereas the power load normally is confined to 10 hours per day. It does not seem to be clearly understood that the domestic load has greater possibilities than the power load. Glasgow, for example, it is estimated, has in the aggregate a power load equivalent to 1,000,000 H.P.; and allowing for what is known as the diversity factor, the electricity department of the Corporation could supply that load with 400,000 KW. of generating plant. On the other hand, after making allowances, there are 228,000 occupied houses in Glasgow. Taking these at 3¼ KW. per house, we should require 721,000 KW. of generating plant to meet their demand. Further, the output for power purposes, basing the estimate on 55½ hours' use of the maximum demand per week, would be 1,150 million units per annum, whereas the output for domestic supply, based on the above-mentioned experiments, would be 2,683 million units. Thus the securing of the domestic load on the mains is at least of equal importance, as a commercial consideration, to that of the power load, so far as the public supply of energy is concerned. If one extends the point of view from the cash nexus and the profit and loss account of electricity supply, to the question of public health, the whole problem takes on a fresh complexion, and arguments in favour of encouraging the use of electricity in the home are overwhelming. The advocacy of the importance of the domestic load in this connection is not to be construed as an attempt to minimise, or to throw cold water on, the power load. The industrial importance of an ample, cheap, and reliable supply of electrical energy is of the first national consequence. The present article is rather intended to show that the encouragement of the domestic load along with the development of the power load will beneficially affect both, and will tend to cheapen electrical energy to the whole body of consumers.

The curve on fig. 1 shows an average week-day load on the Glasgow mains, and gives a load factor of 40 per cent. for the 24 hours. For the whole year the load factor was 27 per cent. The output was 170 million units and the maximum demand 70,000 KW., approximately one-sixth of the demand to be expected from the total power load of the city.

Fig. 2 has been made by adding together the load curves of the two experimental houses and multiplying the addition by 8,000. The result is a maximum demand of 75,000 KW. and an annual output of 185 million units, the actual consumption being 169 millions. It will be seen, by reference to fig. 3, that the domestic load of 16,000 houses—about one-twelfth of the number in the city—

would more than double the present output, with an addition of only 57 per cent. in plant capacity.

Fig. 3 is a combination of figs. 1 and 2. It shows an annual load factor of 55 per cent. as compared with the present load factor of 27 per cent., or 63 per cent. as compared with 40 per cent. week day load factor referred to in fig. 1.

Fig. 4 shows the domestic curve multiplied by two, and superimposed on fig. 1, by means of which we obtain a curve

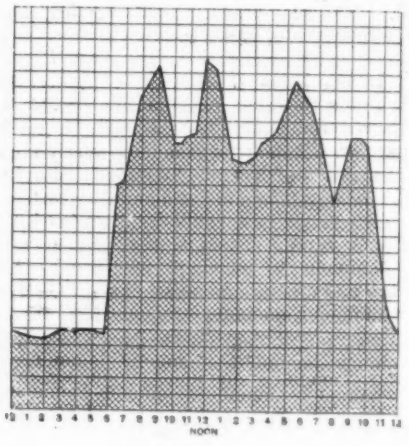


Fig. 3.

showing one-sixth of the possible obtainable load for power and domestic supplies. It will thus be observed that the main load runs up to 120,000 kw., and extends over 18 hours out of the 24, while the peaks average 1¾ hours' duration and, multiplied by 4, give a total of 7 hours' use of the peak load per day. The comparative figures for the existing main load are 9½ hours out of the 24, or just

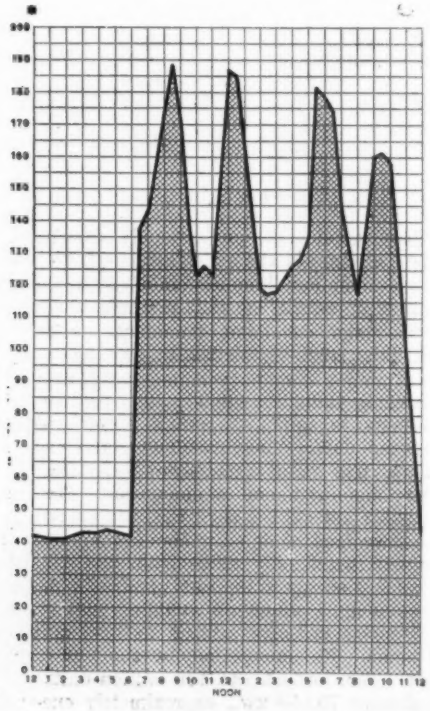


Fig. 4.

2½ hours more than the new peak load, while the extent of the peak at present has an average of one hour's duration as against the new figure of seven mentioned above.

When it is considered that no allowance has been made for tramways, electrochemical processes, for the electrification of general vehicular traffic, &c., it will be seen that the load could be made nearly uniform throughout the entire day, and thus reduce the standing charges to nil. Moreover, the economy in coal consumption through larger plant units, together with reduced capital and labour charges, will further contribute to the possibility of reducing the price of electrical energy to all classes of consumers. The foregoing figures are also based on coal remaining at its present high price. Although the Glasgow experiments show annual bills of £32 and £35 per house, by the simple development of the industry on economic lines, it is not too much to expect that we should, at least, obtain electrical energy for domestic purposes at ½d., instead of ¾d., which would mean that the annual bill for electrical energy for all purposes in a working-class home would be £22 to £25, as against £16 for coal and gas.

The question, therefore, is: Are the people prepared to purchase immunity from the dirt, dust, domestic drudgery, and atmospheric pollution, consequent upon the use of coal and gas, at the small extra cost of, say, 2s. 6d. per week for electricity? The present writer ventures to think that with the foregoing facts before them, the people of this country will unhesitatingly cast their vote in favour of the universal adoption of electricity for all purposes.

Meanwhile, the nation ought to be prepared to take the opportunity of the large housing schemes at present under consideration to revolutionise currently accepted ideas with regard to lighting, heating, and cooking installations in domestic premises. In a word, the ideal in housing ought to be the chimneyless house which would solve along economic and sound commercial lines the whole problem of atmospheric pollution.

SWITCHBOARD EXTENSION.

By F. A. P.

In the early days of electrical plant, the switchboard was merely a board upon which were mounted various instruments and switches symmetrically arranged, the back being usually a maze of loose wiring, making extension difficult. In the course of time, it was divided up into separate panels, and each machine, &c., had all its gear mounted on one panel, so that extra panels

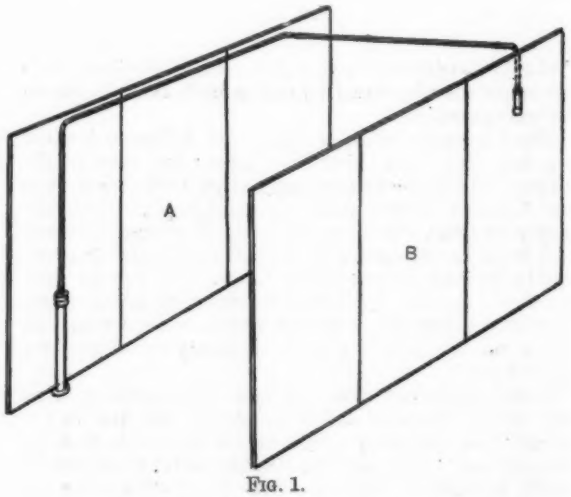


Fig. 1.

could be more conveniently added. Other arrangements more suitable for rough usage, now in vogue, consist of armoured units which can be placed side by side to form a complete switchboard.

Now these later arrangements are a great improvement on the earlier boards, but the writer has yet to see a really flexible arrangement carried out in practice. The average board has panels crowded on the back with apparatus and cables, and with busbars crossing horizontally, making it practically impossible to extend, and

at the same time keep to the orderly arrangement of panels originally installed. When an alteration or extension is required the board as a whole is unnecessarily complicated, say, by adding generator panels at the end of the existing board beyond the feeder panels, or *vice-versa*.

Now, if all machines, feeders, &c., had their cables run to the nearest point on the wall behind the switchboard, or preferably on a separate frame mounted just clear of the wall, and were then cross-connected to their

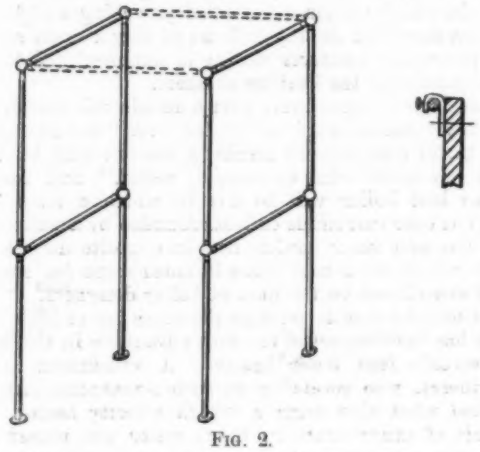


Fig. 2.

particular control panel, a far more flexible arrangement would be obtained. The wall or back frame would be the permanent board, but the front frame would carry panels which could be rearranged.

Referring to fig. 1, A is the back frame where all feeder or machine cables terminate, B is the switchboard proper which can be added to or any section moved if the cross connecting cables are lengthened or shortened to suit. If these consisted of standard lengths and sections of copper rod with clamping connectors, this could easily be done.

On the type of board suggested busbars would not cross the panels, but would have a panel to themselves, and need be only of sufficient length to take all the required connections. This need not necessarily entail extra expense in copper if the connecting cables take the shortest possible route.

Another point is that the switchboard cannot usually be safely worked on when alive, chiefly owing to overcrowding. But it should be possible to do so, in order to avoid shutting down for this purpose, and the avoidance of crossing busbars would distinctly assist in this direction, combined with the use of box spanners well taped or insulated. These can be purchased very cheaply nowadays.

The writer suggests that all boards should be made as simple at the back as on the front, and that rheostats, &c., should not be mounted directly on the back unless one can easily get at the cable lugs. Where they are difficult of access a separate slate terminal block might very well be used.

Frames should be of a uniform size, say, 7 ft. 6 in. by 2 ft. 6 in., if the size of the largest apparatus will allow, and should have adjustable horizontal members. One wonders why the American system of tubular frames is not more often adopted, being simple to build up, extend, or dismantle.

Some lengths of piping and a stock of fittings take up little space, and would be much appreciated by the engineer called upon to put up a temporary board for testing or other purpose, or a back and front frame might be made up, and kept in stock, ready to be joined up by two or more pieces of piping to make a box frame which would stand anywhere. Apparatus or slates could be hung on the tubing by simple hooks or clamps for temporary use, as in fig. 2. This frame would be used up in the main switchboard when it was required to extend it.

When we really do get our cheap electricity, extensions and alterations will be of more importance than they are, perhaps, at the present time, but the time will come, and users of power will be well advised to keep in mind this possibility when installing plant, and put in switchboards capable of some such flexibility as outlined above.

HEAT TRANSMISSION AND BOILER EFFICIENCY.

By EDWARD INGHAM, A.M.I.Mech.E.

Although the question of heat transmission through metal plates is one of great importance to all engineers, and particularly to designers of steam boilers, economisers, and feed water heaters, &c., very few subjects are so imperfectly understood. It is perhaps no exaggeration to say that comparatively few engineers are acquainted with the laws of heat transmission, and in the light of the numerous experiments and researches which have been made during recent years, this is a matter of surprise. A thorough knowledge of the subject is absolutely essential if improvement in existing designs of steam boilers and similar vessels is to be effected.

In the early days of steam boilers, it was commonly believed that the efficiency of the heat transmission through a metal plate depended almost entirely on the nature of the metal, and on the thickness of the plates. Hence it was thought that, since copper was a better conductor of heat than steel, this metal, although inferior in tensile strength, was a more suitable material for the construction of a boiler. As time went on, and more experience of the working of steam boilers had been obtained, it was found that soot and dirt, scale and grease, offered a far greater resistance to the passage of heat from the furnace gases to the water in the boiler than did the plates themselves.

The prevailing idea at the present time appears to be that the principal factor in preventing the free flow of heat from the hot gases to the water is scale, and figures are frequently given to show how seriously the efficiency of the boiler falls off if scale be allowed to accumulate on the plates. Thus, it is stated by one authority that the percentage loss of fuel due to layers of scale 1/64 in., 1/16 in., ⅛ in., and ¼ in. thick are respectively 2 per cent., 9 per cent., 18 per cent., and 38 per cent. Too much reliance should not be placed on such figures, since so much depends upon the particular nature of the scale. They will, however, serve to show that scale is an important factor in reducing the efficiency of a boiler. In the same way, soot, being a very bad conductor of heat, has also a serious effect. The importance, therefore, of maintaining the plates clean on both the water side and the fire side cannot be too strongly urged.

Supposing, however, the plates to be perfectly clean, the amount of heat which is actually transmitted through them under working conditions is surprisingly small. For example, the amount of heat which may be transmitted through 1 sq. ft. of clean plate per hour is given by the formula:—

$$q = \frac{k\,(t_2 - t_1)}{T},$$

where q = the quantity of heat transmitted in British thermal units per hour.

t_2 = the temperature of the hot side of the plate.

t_1 = the temperature of the cooler side.

T = the thickness of the plate in inches.

k = a constant, which for mild steel is 450.

If we apply this formula to the furnace plates of, say, a Lancashire boiler, where the temperature of the hot gases is 1,400 deg. F., and the temperature of the water 350, we find that the heat transmitted per sq. ft. per hour through, say, ½-in. plates, should be:—

$$q = \frac{450\ (1{,}400 - 350)}{\frac{1}{2}} = 945{,}000 \text{ B.TH.U.}$$

Now in actual practice, the amount of heat actually transmitted will be only about 5,000 British thermal units per sq. ft. of heating surface per hour. It will be seen, then, that the heat actually transmitted through a boiler plate is only a very small fraction of the heat which would be transmitted through a clean plate of the same material and thickness, with the same temperature range. Evidently, in the case of a boiler, there must be present on the plates certain agents which are seriously impeding the free flow of heat from the hot gases to the water. It would appear that these agents comprise a stationary film of gas on the fire side, and a similar film of water on the water side.

The experiments already referred to have served to show that if these stationary films, particularly the gas film, be removed, the heat transmission is enormously increased, and such removal may be effected by compelling the gases to move over the plates at high velocity. The generally accepted opinion amongst engineers has hitherto been that if a maximum of heat is to be extracted from the furnace gases, the latter shall not be allowed to move too rapidly over the plates, and hence

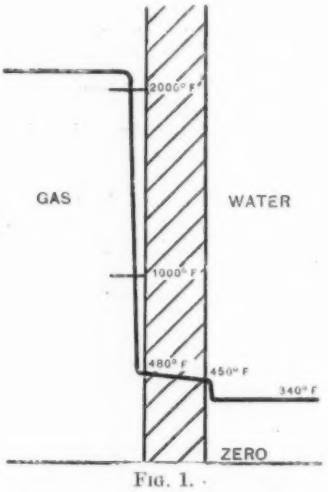


Fig. 1.

designers have been inclined to arrange that the gases shall remain in contact with the hot surfaces long enough for them to give up as much as possible of their heat to the water. For example, it is sometimes argued that the brick-work flues of Lancashire boilers should be made of large sectional area in order that the speed of flow of the gases will be slow. There can, however, be no longer any question that if a high rate of heat transmission is to be obtained, the gases must flow rapidly over the hot plates.

More than forty years ago, Prof. Osborne Reynolds showed that the rate of heat transmission increases as the speed of flow of the gases increases, and a year or two later, some experiments made in France proved that by closing up one-half of the tubes in a locomotive boiler, the heat transmission was again increased.

The late Prof. Nicolson, of Manchester, after carrying out exhaustive experiments, concluded that the rate of heat transmission depended principally upon the product of the speed and the density of the gases, but that the average value of the gas and metal wall temperatures, the nature of the metal surface in contact with the gas, and the hydraulic mean depth of the tubes through which the gases passed, were also factors which influenced the rate of heat transmission. As the result of his experiments, he designed a boiler of a modified Cornish form, in which the gases were forced through the tubes at high velocity by means of a powerful fan. The boiler was, in fact, a forced draught steam plant, where the draught was an unusually high one. The rate of evaporation in this boiler was extremely high, higher, in fact, than had previously been obtained in any other boiler, but the efficiency was seriously reduced because a large amount of steam was consumed in driving the fan.

From what has been said, it will be evident that the problem to be solved by boiler designers who desire to obtain a high efficiency is that of procuring a high speed of gas flow with the expenditure of only a small amount of power for whatever device is employed for forcing the gases over the heating surfaces.

Many years ago, Prof. Perry, in his well-known book on the "Steam Engine," stated that "the surfaces of the metal wall must be scrubbed, the one with hot gases and the other with circulating water," and further, "the best boiler will be one in which a flame or a hot gas tube surrounds or is surrounded by a water tube, the gas and water flowing fast in opposite directions."

It will be seen that there is much scope for research and experiment on the part of boiler designers.

It may be mentioned that the principle of high speed flow has been employed to great advantage in the design of certain feed water heaters. A well-known firm of engineers, who specialise on such apparatus, have designed what they term a "high velocity heater," the result of experiments in which water was passed over the steam heated surfaces at a considerable velocity. It was found that the quantity of heat transmitted was very much greater when the flow was rapid than when sluggish. It is claimed for this high velocity heater that the feed water may be heated some 20 deg. F. higher than is possible with heaters of the ordinary type.

Those who wish for further information on this important question of heat transmission will find the subject fully treated in a paper by Prof. Nicolson, entitled "Boiler Economics and the Use of High Gas Speeds," published in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland, 1911. Although we are unable to discuss this paper here in detail, we have thought it advisable to reproduce a diagram (see fig. 1), which Prof. Nicolson has given to show the enormous effect of a stationary film of gas on a boiler plate in impeding the passage of heat from the furnace gases to the water in the boiler. It will be noted that the original temperature of the gases is taken to be a little over 2,000 deg. F., but the temperature at the point of entering the plate has fallen to 480 deg., and at the other side of the plate, to 450 deg. A further drop then occurs, due to the presence of scale, the final temperature of the water being 340 deg. F., which corresponds to a steam pressure of approximately 100 lb. per sq. in. gauge. According to Prof. Dalby, the fall in temperature due to the resistance of the gas film, is about 97 per cent.; that due to resistance of the plate, 1 per cent.; and the fall due to the resistance of the water film, 2 per cent. Evidently, so far as heat transmission is concerned, the resistance offered by the boiler plates is so slight that it is of practically no importance.

Another Oil-Electric Yacht.—The Westinghouse Electric and Manufacturing Co. has been awarded the contract for supplying the electrical propulsion equipment for the yacht *Guinivere*, which is being built by George Lawley & Son Corp., Neponset, Mass., for a member of the New York Yacht Club. The *Guinivere* is to be a three-masted schooner, with oil-electric auxiliary power, and will be 195 ft. overall, 150 ft. water-line, and 32½ in. beam. Her draught is 15 ft., and her displacement 642 tons. Her power plant is to consist of two six-cylinder, 350-H.P. Winton-Diesel oil engines of 225 R.P.M., each of which is directly connected to a 225-KW., 125-volt, D.C. generator. Each engine drives also, through a chain, a 15-KW. exciter, which supplies the field current for its generator and the propeller motor, and, in addition, power for other purposes. The propeller is connected through a clutch to a 550-H.P., 250 volt motor of 220 R.P.M. Normally, the two generators connected in series will supply current to the propeller motor, but the control is so arranged that either can be used alone to operate the propeller at reduced speeds or in case of emergency.—*Electrical News*, Canada.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Liquid Motor Starter.

Among the more recent developments of the General Electric Co., Ltd., 67, Queen Victoria Street, E.C.4, is the liquid starter shown in fig. 1. This consists of a sheet steel tank, three earthenware chambers, top and bottom electrodes, operating gear, and accessories. The earthenware chambers, in which the electrolyte is placed, are enclosed in the tank, thus preventing leakage should the earthenware be cracked. The cast-iron electrodes fitted to the lower ends of the chambers are connected through porcelain insulators to the cables from the rotor terminals. The insulating bushes on the lower side of the bottom contacts are protected by a shield against any leakage which might cause short circuits. The electrodes are supported on mild steel

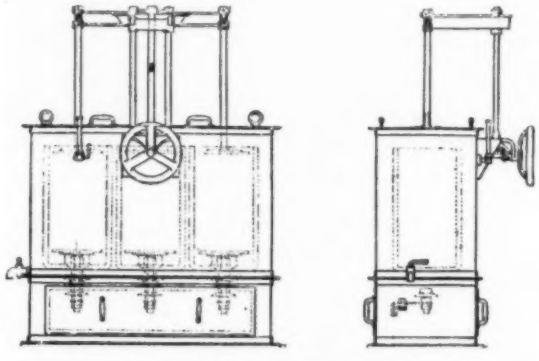


Fig. 1.—G.E.C. Liquid Starter.

rods, and connected together at the top with laminated copper strips. These dipping contacts make an efficient contact with the bottom electrode, and there is no residual resistance. To obviate flashing the starter is so designed that the electrodes are always immersed. The operating mechanism is provided with springs which are compressed as the handwheel is screwed down. At its lowest position the handwheel comes against a stop which prevents overwinding and ensures that neither the pots nor insulating bushes are overstrained. It is claimed for this starter that it is capable of starting a motor against twice full-load torque in 1¼ minutes three times every half-hour.

A Watertight Tumbler Switch.

The Delta Electrical Co., of Temple Courts, Temple Row, Birmingham, has recently placed on the market a 5-amp. tumbler switch which possesses the following features: It is operated by an external dolly, as shown in fig. 2, and it is

Fig. 2.—Watertight Tumbler Switch.

wired without the removal of the interior. All external metal parts are in electrical continuity, so that it is impossible to sustain a shock when the switch box is earthed. It is rendered watertight by a packing washer between the lid and box. This washer is made of specially-treated asbestos, and is claimed to be acid, steam, and moisture proof.

Baking Carbon Electrodes for Electric Furnaces.

La Technique Moderne states that French patent No. 488,778/1918 has been granted to Det Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank in respect of improvements designed to overcome the low initial conductivity which prevents the baking, by electricity, of mixtures of carbonaceous matter and binders forming electrodes for electrolysis or electric furnaces. The difficulty is that the initial conductivity of the formed electrode is so low that it is only possible to send through it a current of about 1 amp., whereas some hundreds or even thousands of amperes would be required to bake the material. The invention provides for the mixture of coke, graphite, tar, and pitch being formed in a mould round one or more iron or other metal rods extending the length of the mould. The current used for baking passes at first through the metal bars and gradually extends to the whole of the electrode as the conductivity of the latter improves. The specification states that 20 electrodes in series may be connected to the secondary of a variable voltage, 220 amp., 110 volt transformer. Commencing at 800 amps., the current is increased to 2,500 or 3,000 amps. during the final stages of baking. The baking occupies 25 to 35 hours, and the electrodes are allowed to cool in the furnace for 36 hours. The size of electrode is not stated.

Electrodes of this type for lofty metallurgical furnaces may be baked *in situ* if arrangements be made for continuous mixing and baking. Waste heat from the furnace then contributes to the baking. Fresh sections of electrode are

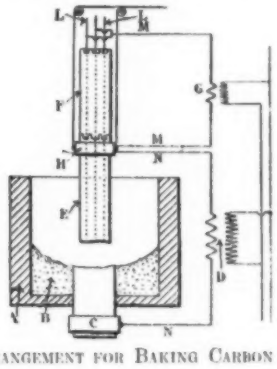


Fig. 3.—Arrangement for Baking Carbon Electrodes.

moulded and baked to keep pace with the consumption in the furnace. By employing the arrangement shown diagrammatically in fig. 3 the current required for baking and the cross section of the metallic reinforcement in the electrode may be reduced to a minimum. The furnace A, charge B, lower electrode C, and main transformer D are arranged as usual. The equipment for continuous moulding of the upper electrode is omitted for simplicity. The lower part of E is baked completely, and carries 18,000 amperes. The upper portion F is newly moulded, and is heated by 2,000 amps. derived from the auxiliary transformer G. The reinforcing bars L, and the connections M have only to carry 2,000 amps.

Templet for Cutting Commutator Mica Segments.

Commutator micas are usually cut by first laying one of the segments on a sheet of mica and marking out the desired form, after which the segment is cut out with a pair of shears. This method, even at the very best, does not produce segments that are of uniform shape. If a rigid construction of the commutator is to be obtained, not only must

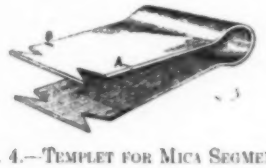


Fig. 4.—Templet for Mica Segments.

the insulating segments be of the proper thickness, but the V's in them must be uniform in shape and size, as also the part of the segment on the inside of the commutator.

To obtain uniformity a templet, similar to that shown in the figure, may be used as a guide in cutting the segments. It is made of a piece of 1/16 in. iron bent in the shape

indicated. After this has been done the two sides of the templet are gripped in a vice and the V's cut the exact shape of those in the commutator for which the insulator is being cut. A notch is cut at A to indicate the maximum width of the mica, and another at B to give the minimum width. The mica is cut to the approximate width of the segments, and then the templet is filled tight with these strips. While being held in a vice, the insulating segments are cut to the required shape with a hacksaw. A notch is cut in the mica at A and B to give the maximum and minimum width, so that after the segments are removed from the templet the excess material can be cut off with a pair of shears. The outside dimensions of the segments need only be approximate, since the excess material can be removed when the commutator is turned down.—*Power.*

THE COMMERCIAL APPLICATION OF ELECTRICAL OSMOSIS.

In a paper bearing the above title, read before the Royal Society of Arts on May 19th, Messrs. J. S. Highfield, M.Inst.C.E., M.I.E.E., W. R. Ormandy, D.Sc., and D. Worthall-Laurie, F.I.C., put forward the results of practical work in this direction. The first part of the paper dealt with the definition of terms and the history of the study of matter in a colloidal state. After a brief general survey of the subject the paper was devoted to the application of the principles involved to the purification or practically the reconstruction of clay. The late Count Schwerin demonstrated that the addition of small quantities of an alkali to a suspension of clay in water resulted in the particles becoming highly mobile, and in the impurities such as pyrites, mica, &c., falling to the bottom of the vessel. The addition of an acid caused coagulation of the particles. Mr. Highfield proved to the audience by experiment that this was so. It was found that bodies in suspension in an electrolytic solution which tended to move to the cathode required an acid electrolyte to bring about the necessary dispersion or peptisation, whereas bodies with a tendency toward the anode required a solution of an alkaline character. By means of a simple device, a copper anode in an alkaline solution in which clay was suspended, the principle was demonstrated, and the audience was shown how in a remarkably short space of time the anode became covered with a thick layer of purified clay. Photomicrographs taken by means of polarised light showing the osmosed material and the deposits of felspar, quartz, mica, &c., were exhibited.

The commercial development of the principle of osmosis was described. The machine used consists of a tank, containing in its lower part two paddles which keep the suspension in continual movement, and drive it in a steady stream between the cathode and anode. The latter is a metal cylinder revolving at a speed of about one revolution in three minutes. The cathode surrounds the lower half of this cylinder, and there is a space of three-quarters of an inch between the two. A scraper is fixed against the direction of rotation of the anode and takes off the deposit to a chute over which the clay moves in a continuous "blanket." Fresh clay suspension is introduced into the lower part of the trough in a continuous stream, and the effluent water is returned to be mixed with more clay. The action of the machine is as follows: The clay in suspension, passing through the perforated cathode, becomes negatively charged, and immediately moves to the anode, while the water is attracted to the cathode forming a watery zone. Fresh clay entering the machine passes through this zone, and all the impurities are washed away with the effluent from the machine. As the effluent invariably contains some clay in addition it is taken to a settling tank, where the mica and other impurities settle out, and the rest of the effluent is then put into a mixing machine from which the osmosis machine is fed. The clay leaves the machine in the form of a sheet varying from one-quarter to one-half of an inch in thickness containing a little water which, owing to the loose form of the material, is easily expelled. By means of such a machine with a cylinder five feet long and two feet in diameter a total of 1,000 tons of purified clay may be produced per annum. The working cost varies widely with the class of clay treated, the amount of energy required ranging from 20 to 70 B.O.T. units per ton of material produced. A small-scale working model was put into motion, and operated very effectively. Another application of electro-osmosis was then described. This is a filter press which has been developed for the de-watering and purifying of many substances in a finely divided state. In its simplest form the press consists of a series of chambers into which the suspension is fed at a sufficient head to ensure a rapid filling. The chambers are closed in on both sides by filter cloths, but the latter are held in position by grooved or perforated metal or carbon plates, one forming an anode and one a cathode. An electrical pressure of from 20 to 100 volts, depending on the substance being operated upon, is established between the plates, and the water is forced towards the cathode. Materials fine enough to choke the ordinary filter press can by this means be de-watered, and the press can, therefore, be used for filtering clays and other colloidal materials which the ordinary press cannot deal with.

In the discussion which ensued upon the conclusion of the reading of the paper, Sir Herbert Jackson paid a glowing tribute to the results obtained by electro-osmosis in the production of purified clay. Owing to the high temperatures to which vessels made of this clay could be subjected, combined with a low sintering temperature, the manufacture of high-grade optical glass had been facilitated to a great extent.

Mr. Walter Hancock also spoke of the great advantages to be obtained from clay produced by this process in the production of optical glass, and said that after using the "ore" for so many centuries they had at last got down to the "metal."

Mr. Murray Morrison predicted a large field of application of electro-osmosis in the near future.

Mr. Patchell referred to the fact that prior to 1910 the process was in use in Germany, but had been "turned down" by this country chiefly on the part of Cornish manufacturers, whose methods were hard to change, especially as sales were already abreast of supplies.

Mr. Goodwin asked if the principles could not be applied to peat production and the decomposition of sewage.

Dr. Ormandy, in his reply, said that crucibles made of clay produced by electro-osmosis had been found to withstand a temperature of 1,500 deg. C. for fifteen journeys, whereas the ordinary crucibles, besides introducing iron and other colouring matter, would not withstand three charges. Peat could easily be dealt with by the process, but the treatment of sewage was a much more difficult and complicated matter. There were at present several works in Austria producing clay in very large quantities by electro-osmosis, and even Spain had become alive to its possibilities.

THE SYNTHETIC MANUFACTURE OF NITRATES.*

In the fixation of atmospheric nitrogen by the electric arc, the reaction depends mainly upon contact of the air with the arc, and the best device is clearly that which brings most air under the action of the arc. In single-phase furnaces a considerable percentage of air escapes this action; thus in the Birkeland-Eyde furnace, the arc alternately fills the higher and lower halves, but never both simultaneously. Then as the air penetrates into the chamber of reaction through all the orifices it results that only half this air is on the side where the arc has been emitted at the same instant, whence there is a loss of air, especially for the orifices near the circumference. Analogous inconveniences have occurred with the Schönherr and Pauling furnaces.

In three-phase furnaces the three electrodes, separated by refractory bricks, are placed so as to entirely surround a pyramidal space with six sides, which air, entering at the base, gradually fills before passing out through the single opening at the top. The three-phase currents which feed the electrodes produce an arc rotating with the frequency of the source, viz., at the rate of 50 revolutions per second, and as the air requires more than 1/50 second to pass through the reaction chamber, each particle is brought into contact with the flame.

For good working of the furnaces it is essential to blow the arc. This can be done either with a permanent magnetic field (Birkeland-Eyde) or a variable magnetic field (Moscicki), or by the aid of the air passing through the furnace (Schönherr, Pauling, Kilburn-Scott). The inconvenience of magnetic blowing is that it necessitates direct current to feed the electro-magnets. The substance of the electrodes exerts considerable influence on the production. The Birkeland-Eyde electrodes, for example, are copper alloy, which experience has demonstrated to be very advantageous. In some Pauling furnaces, at Legnano, Dr. Rossi utilises electrodes made of an aluminium alloy, which, it appears, exerts a catalytic action favourable to the reaction. Single-phase furnaces are set working by bringing the electrodes together until the voltage applied is sufficient to produce the arc. With the high voltages usually employed, there is danger of intense rushes of current and excessive voltage. In three-phase furnaces there is no regulation, the arcs are excited with auxiliary sparks; this enables the electrodes to be kept at the optimum distance.

In all electric furnaces it is of very great importance to make working continuous, because extinguishing and igniting the arcs may cause excessive voltages and other harmful phenomena. The three-phase furnace has a marked advantage in this respect, because the phases are always traversed by currents, and the arcs are mutually maintained. The power is always practically at a maximum, whereas in a single-phase furnace it passes from zero to the maximum value, twice per period.

Preliminary heating of the air gives economy in heat, raises the temperature of the furnace, and also dries the air. This, according to Prof. Guye, gives a slight increase in production. It facilitates ionisation also, and consequently the working of the arc. A temperature of 250 deg. C. gives good results. It

* From *L'Engrais*, January 9th, 1920.

is profitable to obtain this heating with gas from the reaction chambers.

A high-efficiency heater can feed several furnaces.

The chemical reaction being reversible, it is important to cool the nitric oxide produced rapidly. In single-phase furnaces this cooling is obtained with excess of air blown into the reaction chamber.

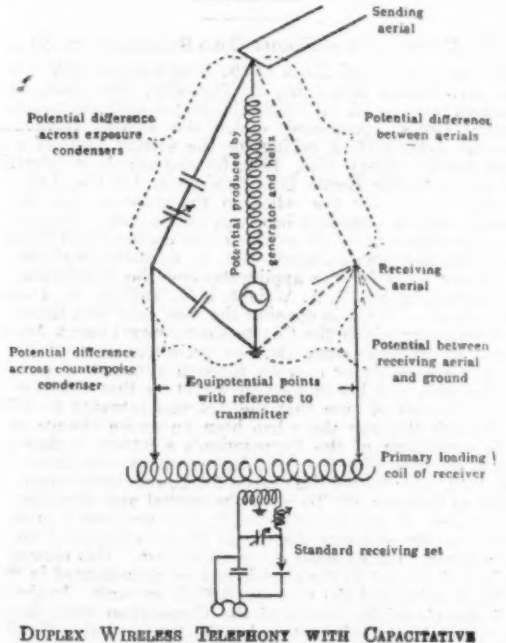
Mr. Kilburn-Scott prefers to make the upper part of the furnace in the form of a boiler upon which the blown electric arc acts much the same as an ordinary flame. The centre of the flame is the neutral point, and the boiler being earthed there is no disturbance in the electric connections. The metal of the boiler is not attacked by nitric oxide (NO). It might be so by nitrogen peroxide (No_2) at a tmeperature below 600 deg. C. The attack, however, is slow, and necessitates the presence of humidity.

The generally accepted production for single-phase furnaces is 50 to 60 grammes of nitric acid, pure, per kilowatt-hour, corresponding to one metric ton of acid per kilowatt-year. With three-phase furnaces, Kilburn-Scott obtained a 50 per cent. greater efficiency. By placing a boiler above the furnace the same author states that about 10 per cent. of the total energy can be recovered.

The voltage is about 1,500 volts. With properly working furnaces one can obtain a power factor of 0.5. The most commonly utilised system of absorption is constituted by a series of high towers, built of bricks, acid proof, and filled with quartz pebbles or other materials which resist acids. The first condition to obtain good absorption is a very slow circulation of the gases. The surface of contact must also be as great as possible. Moscicki runs the liquid down, intermittently, so that the substances in contact will be alternately wet and dry. This, it appears, greatly improves absorption (97 per cent.), and gives nitric acid with a concentration of 40 to 50 per cent.

DUPLEX WIRELESS TELEPHONY AND SELECTIVE RECEPTION.

The first part of a paper which was read by Mr. E. F. W. Alexanderson before the Institute of Radio Engineers, N.Y., deals with duplex wireless telephony, and the second part with a highly selective "barrage" receiver. In the duplex method described, the speaker can hear the called party without manipulating a switch to transfer from sending to receiving. For this to be possible it is necessary to neutralise the intensity of the transmitted signal, and the first method that yielded


Sending aerial
Potential difference across exposure condensers
Potential difference between aerials
Potential produced by generator and helix
Receiving aerial
Potential difference across counterpoise condenser
Equipotential points with reference to transmitter
Potential between receiving aerial and ground
Primary loading coil of receiver
Standard receiving set

DUPLEX WIRELESS TELEPHONY WITH CAPACITATIVE NEUTRALISATION.

practical results was the use of separate sending and receiving antennæ, located sufficiently far apart that the selectivity of ordinary receiving instruments could differentiate between the wave lengths of the receiving and sending stations. The subscriber and sending stations are connected like two ordinary subscribers on a central exchange, with the only difference that a transformer with its primary winding connected across the line from the receiving station is, by its secondary, permanently introduced in series with the line to the sending station. A telephone current originating in the receiving station is thus transformed into a current flowing in the closed circuit between the subscriber's instrument and the instrument in the sending station. A telephone current originating in the subscriber's instrument will follow exactly the same path. Both these currents will, therefore, be transmitted by the sending station, and both sides of the conversation may, in fact, be heard by a third party tuning his apparatus to the two wave lengths. This system is suitable for inter-connection with wire telephone exchanges.

The most practical method consists in mounting the sending and receiving antennæ on the same masts, and preventing mutual interference between them by inductive or capacitative neutralisation. In the former method, an inductive coupling is provided between the two aerials by a transformer connected in such a manner that it creates in the receiving antenna a potential opposite in phase to the potential directly induced by the sending antenna. The second (capacitative neutralisation) method is explained by the figure.

The bridge receiving set connections are analogous to a Wheatstone bridge. By adjusting the condensers in the bridge arms extremely perfect neutralisation is possible of the effect of one antenna on the other. Local strays may be effectively neutralised by intercepting them on a wire loop in the neighbourhood of the receiving set and impressing the potential so generated on a little coil mounted with an adjustable coupling close to the secondary loading coil of the receiving set.

The "barrage receiver" is a highly directional combination of aperiodic antennæ with unilateral directional characteristics. When two antennæ are used, the phase difference of the received currents depends on the direction of the incoming signals. By phase-shifting devices and differential coupling to a common receiver the signals from any given direction can be balanced out. Each antenna is connected to earth through an intensity coupler, the secondary of which is connected to the primary of a phase adjuster, built in the form of an induction regulator. The primary current is connected in split phase so as to produce a rotating field that cuts the secondary windings. The neutralisation of the signals from any particular direction is effected by adjustment of the intensity couplers and phase adjusters.

An experimental set was erected three miles from the New Brunswick station, the wave length of which is 13,600 metres. Nevertheless, signals from Carnarvon, Wales, with 14,200 metres wave length, were received, the signals from the New Brunswick station being entirely eliminated, notwithstanding their intensity and small difference in wave length. By using a double set of phase adjusters, signals from two stations in different directions may be neutralised simultaneously.—*Technical Review.*

SOME DEFECTS IN ELECTRODEPOSITED IRON.

By W. E. HUGHES, B.A.

(*Abstract of paper read before the* Iron and Steel Institute.)

The electrodeposition of iron has lately been employed to a considerable extent for the purpose of "building up" worn and under-gauge parts—both of aeroplanes and guns. This work has not been done under proper scientific control; and the observations made during this research show that results obtained in the workshop, though apparently satisfactory, are very far from being so in fact.

Microscopic and macroscopic examination shows that electrodeposited iron is subject to the following defects:—

1. Pin-holes.
2. Lumps (or roughness).
3. Inclusions (of foreign matter).
4. Cracks and quasi-cracks.
5. Differences of structure—at different parts of the same specimen.

Pin-holes (or "pits") are due to gas which is liberated by the current during electrolysis, and which adheres in the form of bubbles to the articles on which the deposit is being formed. The gas bubble acts as a screen or insulator. The deposit grows up round it, and thus a hole of circular cross-section is formed in the deposited iron. The bubbles are usually said to consist of hydrogen, and probably in the majority of cases that is so. It is necessary so to choose the conditions of deposition that hydrogen evolution is reduced to a minimum, and then to direct one's efforts to removing by mechanical means (agitation of the solution or movement of the articles being deposited upon) the gas formed and adhering to the work.

Lumps very often are caused by the plating solution containing tiny particles in suspension. Sometimes the lumps are rounded and smooth. This result is due to suspended particles having been initially present, and, after settling, having left the solution clear. A lumpy deposit of this kind will often be formed after a plating bath has been for some reason stirred up (*e.g.*, when new salts have been added), and sufficient time has not been allowed in which the sediment, that is always present at the bottom of plating baths, could settle down.

At other times a deposit will be *rough* to the touch. In this case, though the first settled particles have become covered, other layers are being continually formed. This kind of thing will result from the use of anodes that do not wear well, or, in the case of iron, from using anodes containing a high percentage of carbon. The effect on the structure is that it is of a more or less porous type, instead of being compact and dense.

Of the substances occurring as inclusions in electrolytic iron, the following are probably most often recurrent:—

(*a*) Oxide or hydroxide of iron, produced by oxidation of the solution.

(*b*) Hydrogen, produced at the cathode by electrolysis; and

(*c*) Carbon or carbide, that comes from the anodes used, or is derived from a constituent of the electrolyte.

Oxidation takes place quickly and extensively, even when the solution contains acid. The resulting oxide (or hydroxide) becomes disseminated throughout the solution by reason of its disturbance in the practical operations, and is caught up by the deposit. This defect is diminished—(1) If the bath continually contains sufficient acid to prevent the formation of any large amount of oxide (or hydroxide); (2) if the solution be allowed to "settle out," and be then siphoned, at frequent intervals; (3) if care be taken to disturb the solution as little as possible during the operations of putting in and removing the articles to be deposited upon.

Many writers have made statements to the effect that electrodeposited iron owes its brittleness (when it is brittle) to the fact that hydrogen is in some way or other included in the deposit. Such statements are quite inaccurate.

It remains unproven that the cause of brittleness (where it occurs) in electrolytic iron *is* the presence, in some form or other, of included hydrogen.

Carbon is found in electrolytic iron, but there is nothing to show that it causes any structural effect.

Electrolytic iron is commonly thought to be very pure. It may be, and it may not. The impurities, other than hydrogen, probably come, for the most part, from the anodes used. All impurities must be considered as causing the iron to be defective, and, from this point of view, the deposits obtained from solutions containing organic substances must be looked upon with suspicion. Cracks frequently exist, and they form a very serious defect in electrolytic iron.

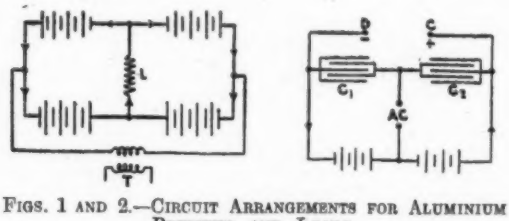
The manifold differences of crystalline structure that are to be found in electrodeposited iron must be accounted as a defect in it. Sometimes complete differences of structure will be found to occur in the same cross-section of one and the same sample.

These defects arise from causes which can be largely eliminated by efficient control and conduct of the deposition process.

It is believed that electrodeposited iron could be used with advantage to a much greater extent than it is at the present time, and that a great saving of material and expense would be effected by such extended employment of it. But the author is sure from long experience that if the electrodeposition process is to be used with success this will have to be done by methods and under workshop and other conditions that are much less lackadaisical and much more scientific than is at present the case.

METHODS OF REDUCING FLUCTUATION IN RECTIFIED CURRENTS.

Fig. 1 illustrates the circuit arrangements of the well-known Nodon system of aluminium rectifiers. Each cell consists of aluminium and lead or carbon plates immersed in a salt solution. T is the transformer through which the current is fed to the circuit, and L is the load. It is found that although this arrangement completely rectifies the current (at no time does it reach a zero value), the fluctuation is very large.



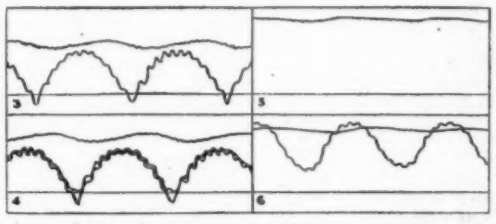
Figs. 1 and 2.—Circuit Arrangements for Aluminium Rectifier and Loads.

Two methods may be employed to "smooth out" the current: (*a*) the introduction of inductance in series with the load, and (*b*) the placing of a condenser in parallel with the load. The effect of the first method is shown in fig. 3, where the upper and lower curves represent the current and voltage respectively. In fig. 4 the curve which just touches the zero line represents the voltage when the load is a non-inductive resistance. The curve that falls slightly below the line represents the voltage with the same total resistance, and the addition of an inductance of 33 millihenries. The upper curve shows the current with the inductance in the circuit.

Fig. 5 is an oscillogram showing a current in the load of 2.5 amps. rectified with the four-cell combination shown in fig. 1. An inductance of 33 millihenries is placde in series with the load, and a 25 mf. condenser in parallel with it. The fluctuation has a maximum value of 1 per cent. of the mean current.

A high voltage can be obtained by employing the inductance without the condenser, but the current is small. This is illustrated in fig. 6. The curve showing the larger variations is the voltage without a condenser. The effect of connecting a condenser of 2.8 mf. capacity across the load is shown by the other curve.

The arrangement shown in fig. 2 makes it possible to obtain a direct E.M.F. more than twice as large as the effective value



Figs. 3, 4, 5, and 6.—Rectified Waves of Current and Voltage.

of alternating E.M.F. The condensers are of 2.8 mf. capacity. At the peak of one-half cycle one of the condensers is charged to the maximum voltage produced by the transformer; i.e., to 1.41 times the effective value of the voltage. The other condenser receives a similar charge at the peak of the next half-cycle. The two are in series, hence the p.d. between terminals D and C is $2\times1.41\times E$, where E is the effective value of the alternating E.M.F. This assumes the wave to be harmonic and leakage negligible.

We are indebted to the *Electrical World* for the foregoing details and accompanying diagrams.

LEGAL.

Bootle Corporation v. Bootle Cold Storage & Ice Co., Ltd.

In the Commercial Court of the King's Bench Division, before Mr. Justice Bailhache, on Thursday, May 20th, an application was heard in which the Mayor and Corporation of Bootle, Lancs., proceeded under the Courts (Emergency Powers) Acts, 1917-19, asking for the setting aside of a contract dated January 19th, 1912, for the supply of electricity for power to the Bootle Cold Storage & Ice Co., Ltd. The plaintiffs asked for the relief on the grounds that through the war and its attendant increases in the cost of coal, labour, &c., the whole basis upon which the contract had been entered into had been changed. Mr. A. T. Miller, K.C. and Mr. M. Bailey were for the applicants, and the defendants were represented by Mr. R. A. Wright, K.C., and Mr. W. Proctor.

Mr. Miller, K.C., in opening the case, said that there were sections under which the Courts Emergency Powers Act gave power to set aside contracts, the performance of which had become impossible or onerous through circumstances created by the war, and his submission would be that this was precisely the sort of case that the Act was intended to relieve, as through the war there had been an entire change in the trade conditions of the Corporation's electrical undertaking. The agreement with the defendant company was dated January, 1912, and it fixed the charge for power supply under two heads as follows: (1) To cover the capital and standing costs irrespective of the quantity used; this was based upon the plant capacity and was charged at £1 per kilowatt of demand per quarter. (2) To cover the running cost. This charge was made with respect to the electricity used as measured in Board of Trade units, and the rate was 0.375d. per unit. In the year 1917 the electricity works of the Corporation were declared a controlled establishment under the terms of the Munitions of War Act, 1915, and they had to be carried on under the Director of Electricity Supply. The consequence was that various new works and large extensions of works were constructed within the Corporation's area of supply at the instigation of departments of the Government, for the production of war material, and the Corporation had to furnish electricity for them, but the Corporation was unable to obtain any sanction to the extension of its area. In December, 1917, it was obliged to get a supply in bulk from the Liverpool Corporation at disadvantageous terms, and at a price that increased the cost beyond that which it would have been if the Corporation had been permitted to extend its works. From 11s. 3d. per ton in June, 1914, the price of coal had increased to 36s. per ton—an increase of 220 per cent— and

wages had risen by some 130 per cent. Figures supplied by the borough electrical engineer, Mr. T. Dawson Clothier, showed that for the year ending March 31st, 1915, the costs with respect to: (1) Capital and standing costs per kilowatt of maximum demand for all consumers were £1 12s. per kilowatt per quarter; and (2) the average running cost per unit of electricity sold to all consumers was 0.435d. per unit. The charge then made to the defendants of £1 per KW. and 0.375d. per unit were fair and reasonable, and in the year in question the undertaking showed a surplus of £3,014 over expenses, but for the year ending March 31st, 1919, very different results appeared, for the figures were: (1) Capital and standing costs, &c., £2 14s. 3d. per kilowatt per quarter; (2) average running cost per unit 0.84d., and a deficit of £7,670 resulted, although the charges for electricity were increased to every other consumer. Since March 31st, 1919, costs had risen still further, and the figures were: (1) Capital and standing costs, &c., £2 19s. 6d. per kilowatt per quarter; (2) average running cost per unit 1.06d. In the case of other consumers the charge for energy had been increased by 3½d. per unit for lighting and from 0.85d. to 1.7d. per unit for power. Mr. Miller, K.C., submitted that this was just the type of case that the Act intended to relieve. He relied on the words in the clause to the effect "alteration of trade conditions occasioned by the war . . . which involved serious hardship in carrying out the contract."

Mr. CLOTHIER gave evidence, and was cross-examined by Mr. Wright for the defendants. He said it was true that the defendants had a reduced charge because they took the supply at a time when there would not be a general demand. They had a summer day load and used it in daylight. The Corporation had another pre-war contract with Harland & Wolf. Later contracts had a coal clause and a percentage clause. There was another cold storage company called the Union Co. now taking supplies. The coal clause meant an increase of over 100 per cent. on the basis price per unit. The bulk of the increased cost was for coal. Witness said that the defendants did offer to pay three-quarters of the coal clause increase dating back to 1918, which would involve an extra payment of £1,200.

Mr. WRIGHT: If your contract is annulled you would not get that retrospective relief, you would have to start from now and make a new contract?—I suppose so, and they would be treated as new consumers.

I understand that in your arrangement with the other company (the Union Cold Storage Co.) you eliminated coal altogether for the purposes of determining if there has been an increase of cost of production, and then you charge a percentage to be settled by arbitration.—Yes.

His LORDSHIP: And the percentage in that way might turn out to be very small on the total price?—Yes, it might turn out to be nothing at all.

Mr. Justice BAILHACHE: This agreement with the defendants really has only two years to run.

Mr. MILLER: Yes, and the parties have been at loggerheads since 1917.

His LORDSHIP said it would appear that if the Corporation allowed the defendants to go on the terms of their offer of three-quarters of the coal clause increase they would be on slightly better terms than were the Union Cold Storage Co.

Mr. WRIGHT: Yes, they would start with 0.3d. instead of 0.375d.

Mr. CLOTHIER explained that there were several differences in the basis on which the Union Cold Storage and the defendants were supplied—which were favourable to the defendants as compared with the other firm.

At the close of the evidence Mr. R. A. WRIGHT said there were two alternatives—one was agreement between the parties and the other was whether the circumstances were such as would justify the Court in annulling the contract. Mr. Wright said the position of his clients was that they had got a contract—they had offered to have the agreement revised to the extent of three-quarters of the coal clause increase with retrospective effect. The defendants' offer was retrospective. He submitted that the position could not be dealt with as if there was no contract at all. The Court must consider the fact that the contract existed. The Corporation's offer was after June, 1918, the whole of the coal increase and up to then three-quarters of it.

Mr. MILLER, K.C., said the Corporation made a fair offer in December, 1917, that had been modified since. The defendants had brought the Corporation to Court to have the matter discussed, and he submitted the plaintiffs should have the costs in any event. It was agreed that the case should be adjourned until the following day for the parties in the meantime to discuss the matter with a view to an agreement, and Mr. Justice Bailhache intimated that subject to Mr. Wright's argument he thought that failing an agreement the contract should be annulled.

When the case was further mentioned, Mr. R. A. WRIGHT, K.C., for the defendant company, announced that his clients had agreed to accept the offer of the Corporation, so that the contract by consent would be amended, increasing the contract price by three-quarters of the coal clause charges as from January 1st, 1918, to June 30th, 1919, and as to the whole of the coal clause charges from July 1st, 1919, to the end of the contract. As this was an application by the plaintiffs for relief, he submitted there should not be any costs on either side.

Mr. Justice BAILHACHE: I do not agree. I think the defendants were unreasonable in the matter. They forced the plaintiffs to come here, and defendants must pay the costs.

The contract was accordingly amended on the terms indicated, and the plaintiffs were given the costs of the proceedings.

IMPROVEMENTS IN ELECTRODES FOR SECONDARY BATTERIES.

In the King's Bench Division, on Wednesday, May 19th, Mr. Justice Greer had before him an action relating to the commercial exploitation of a patent covering improvements in electrodes for secondary batteries (No. 120,671 of 1914-1915). The plaintiff was Mr. Herman Edward Gluck, of Priory Road, West Hampstead, and the action was brought against Mr. S. Willner, of Turle Road, Tollington Park, and Mr. Alfred Connell, Philpot Lane, London, plaintiff claiming damages for alleged breach of contract.

Plaintiff's case was that in February, 1916, Willner requested him to assist defendants with the necessary finance for commercially exploiting the patent. It was alleged that Willner stated to plaintiff that he was the owner of the patent, that he had sold the German and American rights, that he wanted to exploit the English, Colonial, and other foreign rights, and that the patent was held in trust for him by Connell, to whom he would have to allow a small interest for services rendered. In May, 1916, it was verbally agreed that plaintiff should provide the necessary finance for commercially exploiting the patent, and should take offices and register or obtain control of a company with limited liability, and that in consideration plaintiff should have in addition to payment of the money advanced and expenses incurred by him under the agreement, one-third share of the English and Colonial rights or one-third of the profits to be made from the sale of the patent. It was further agreed that Willner should act as secretary of the proposed company. Certain personal loans were made by plaintiff to Willner, who undertook not to dispose of his rights in the patent unless with the plaintiff's consent. Plaintiff said he advanced money and incurred expenses, and took offices at Wormwood Street, E.C. In May, 1917, Connell assigned the letters patent to a gentleman, who afterwards assigned them to the Apex Electric Accumulator Syndicate, Ltd., and plaintiff said he was entitled to one-third of the profit made by defendants from the sale.

The defendant Willner denied that he was interested in the letters patent as owner or partner or joint owner with his co-defendant Connell, or that he ever acted or had any authority to act as principal or agent as alleged. It was alleged by the defence that in January, 1916, Willner introduced plaintiff to the defendant Connell as a person who was able and willing to provide the capital required for exploiting the letters patent commercially, but plaintiff failed to find the required capital, and in August, 1916, Willner informed him that Connell would dispose of the letters patent. The defendant Willner denied that the agreement alleged by plaintiff was ever made.

The defendant Connell also pleaded that there never was any agreement at all between him and the plaintiff. The letters patent were granted to him and were eventually assigned to the Apex Electric Accumulator Syndicate, Ltd.

After hearing the evidence and counsel's address, Mr. Justice Greer said Mr. Willner's own evidence satisfied him that he knew Mr. Gluck was undertaking liabilities and meeting expenses in consideration of a promise made to him. He could not find that Mr. Connell was liable. The breach of contract was due to what Mr. Willner did. He had decided to give Mr. Gluck against Mr. Willner £100 beyond the £94 which the plaintiff had expended, and to which he was entitled, and there would be judgment against the defendant Willner for £194, and judgment for the defendant Connell.

The Belgian Charleroi Works.—The report for 1919 of the directors of the Ateliers de Constructions Electriques de Charleroi states that the expectations entertained a year ago regarding the resumption of production had been realised. It was possible for the Marcinelle works, from which but little machinery had been removed, to make a fresh start in February, and in August the construction of large motors and lifting appliances was resumed at the works of La Villette. The foundry and pattern shop, which had not suffered any damage, were able to work on a normal basis as early as January, but the cable factory had been stripped of all the plant, and was only able to turn out the first cables and insulated wires in September. The equipment of the cold rolling mill had been recovered, and its installation was practically completed, whilst it was hoped to start the new shops for tubes and insulating material in a short time. In addition, the construction of small motors in bulk had been begun at Ruysbroeck, where the signal department was to be transferred from La Villette. Although orders of any importance were not booked until the end of May, the value of the orders received in the whole of 1919 was 45,454,000 fr., and the present year promised to be still more favourable. The accounts for last year show profits of 2,546,000 fr., but after deducting the loss of 2,337,000 fr., incurred in the years 1915 to 1918, the sum of 209,000 fr. remains to be carried forward to 1920.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Policy of the E.P.E.A.

With reference to letters in your issue of May 21st, written by "Sic Itur" and Mr. Jones, Secretary E.P.E.A., I should like to ask them: (1) How many of their members receive the awards they claim for? (2) Have they cleared their minds as to whether they are what they claim to be, viz., genuine trade unionists? (3) If they have, why do they want confirmation at the hands of the T.C.P.C.?

And, further, all their claims are based on the basic rates obtained by the E.T.U., the members of which get what they are awarded. Mr. Jones in his letter does not state that he was absolutely forced to publish something of the sort by a trade union, as a result of two conferences with the E.T.U., at one of which I was present. And the defence they put up was pathetic. There is only one thing for the E.P.E.A. to face, and that is absorption by the E.T.U.

W. E. Weston,
No. 1 Station Engineers, E.T.U.

London, S.E., *May 20th*, 1920.

Electrical Japanning Ovens.

I was expecting to see some comment re the above, and the following will answer Mr. W. M. Mason's ten questions:—

No. 1.—Fittings in gas stove replaced with electric fittings.

No. 2.—See "Electric Japanning Ovens" (ELECTRICAL REVIEW, April 23rd).

No. 3.—The same exhaust flue in use for electric stoves as for gas stoves.

No. 4.—Sufficient to complete the stoving of the work in the ovens.

No. 5.—Long enough to turn out a satisfactory job.

No. 6.—Yes.

No. 7.—To regulate gas-heated stoves requires more care than is required in switching off electric current.

No. 8.—Electric heaters.

No. 9.—Sufficient for the work in the ovens according to the temperature required.

No. 10.—See answer No. 2.

I am not certain what is implied by the term "nigger," but Mr. Mason can take it for granted that my electric stoves are not "white elephants."

Alfred Rider.

Hull.
May 18th, 1920.

BUSINESS NOTES.

Small Electric Lighting Sets for Cuba.—The D.O.T. has received a report from the Commercial Secretary to H.M. Legation at Havana (Mr. G. T. Milne, O.B.E.) stating that there is an opening for the sale of small electric lighting sets of British manufacture. Already some American manufacturers are in the Cuban market, which is not a very large one, but British manufacturers should be able to secure orders, provided they can supply a suitable type of lighting set. It is suggested that firms interested should forward catalogues, lists, &c., to the Commercial Secretary, British Legation, Havana, Cuba, indicating at the same time the present prices and conditions of delivery.

Illuminating Engineering Society.—The Council's report for the 1919-20 session was presented at the annual meeting of the Society, held on May 11th. The arrangement by which positions on the Council are held by the presidents of kindred societies has been extended to include the Illuminating Engineering Society of the U.S.A., the Institution of Electrical Engineers, the Institution of Gas Engineers, the Illuminating Engineering Society in Japan, the Council of British Ophthalmologists, the Ophthalmological Society, the Physiological Society, the Electrical Contractors' Association, and the Association of Railway Electrical and Telegraph Engineers. A list of the subjects dealt with at meetings of the Society includes "Colour-Matching by Natural and Artificial Light," by Mr. L. C. Martin; "Lighting Conditions in Mines, with Special Reference to the Eyesight of Miners," by Dr. T. Lister Llewellyn, as well as reports of Committees, &c. Among the questions investigated by Committees was "Eyestrain in Kinemas," an inquiry entered upon at the instance of the London County Council. Committees were also set up to report upon railway lighting, and progress in lamps and lighting appliances.

Dual Tickets.—The *Journal* of the National Association of Supervising Electricians for May gives correspondence between the Association and the E.T.U. in which the former asked whether the latter would countenance joint membership of more than one Trade Union. The E.T.U. replied that the Executive Council had definitely decided that no member of the E.T.U. could hold two Trade Union tickets.

Motor Fuels Committee.—The Imperial Motor Transport Council, of which Prince Arthur of Connaught is President, and the Hon. Sir Arthur Stanley chairman, has appointed an Empire Motor Fuels Committee under the chairmanship of Mr. E. S. Shrapnell-Smith. The terms of reference are the following:—

1. To take immediate steps to encourage and develop the production and utilisation of additional motor fuel supplies and of raw materials therefor in all parts of the Empire, and more particularly to ensure increasing shipments of motor fuels to Great Britain, and, so far as may be necessary, to the Empire Overseas.

2. To co-operate with any Government or incorporated or unincorporated body of persons in order to further the objects set forth in (1) hereof.

3. To offer for the purposes in view bonuses or other rewards and to incur such expenditure as may be desirable, all such expenditure being subject to the approval of the Council.

Captain F. G. Bristow, F.C.I.S., will give his services as secretary to the committee, and any communications are to be addressed to him at 50, Pall Mall, London, S.W. 1.—*The Times.*

Tests on High-Pressure Box Compound.—Very good results were recorded in a recent report by the National Physical Laboratory on "Berry's" high-tension box compound, supplied by the PREMIER BITUMEN AND ASPHALTE CO., LTD., of Stratford Market, London, E. 15. We understand that a cube of the material to meet Admiralty requirements, placed in a metal box, was immersed in boiling water for 30 minutes, and fulfilled the requirements of the specification. The material was then subjected to a pressure of 2,000 volts between electrodes placed $\frac{1}{16}$ in. apart, for half-an-hour, without breakdown, and when tested again under a temperature of 100° C. for a period of half an hour, an alternating pressure of 2,000 volts was withstood. Two 2-in. cubes of the compound were immersed in distilled and sea-water for a week, and showed an increase in weight of '06 per cent. and '04 per cent. respectively; the specification stated that the weight of neither cube was to be increased by more than '5 per cent.

Three 8-Hour Shifts at Sheffield.—In response to an application by five societies representing the steam service men, the Sheffield and District Engineering Trades Employers' Association have decided to put into operation Award 84 on May 30th. This means that the three eight-hour shifts system will be worked by over 10,000 men, instead of two shifts per day. This arrangement is expected to increase employment and abolish overtime.—*Times.*

Dynamo Manufacturers' Amalgamation.—An amalgamation of interests has been arranged between the Lancashire Dynamo and Motor Co., Ltd., of Manchester, and the Crypto Electrical Co., Ltd., of Willesden. It is intended that all machines below about 10 H.P. shall be manufactured at the Willesden Works, and that machines above this size shall be manufactured at Manchester. Special arrangements have been made to meet the requirements of customers who require to duplicate existing machines of either make.

The Crypto Electrical Co.'s works at Willesden are being extended to double their present size. The extensions are practically complete, and a greatly increased output will be available within a short time. It is hoped that the extensions will ensure the production of approximately four times the existing output of motors from about ¼ B.H.P. up to 10 B.H.P.

The selling organisations of the two companies have been combined throughout the British Isles. The associated firms have branch offices in London, Glasgow, Newcastle, Birmingham, Dublin, Cardiff, and Bristol, and full information regarding the products of both works can be obtained from any of these offices, or from the head offices and works of either firm.

The directors are confident that the increased efficiency obtained by limiting the range of manufacture of each works will greatly increase the combined output, with corresponding benefits in regard to price and delivery.

Canadian Exhibition.—Sir George Perley, K.C.M.G., High Commissioner for Canada, will open the Exhibition of Canadian Products at the Royal Agricultural Hall, Islington, on Thursday, June 3rd, at 12 o'clock. The Exhibition will be open from 11 a.m. to 9 p.m., and will close on June 17th. Up to 2 p.m. each day the Exhibition will be open to traders only. After that hour the general public will be admitted.

The exhibits include iron and steel products, minerals, chemicals, tools, sheet-metal goods, agricultural machinery, furniture, provisions, confectionery, footwear, musical instruments, building materials, &c.

Employment for Disabled Men.—In an endeavour to find work for the 630 disabled ex-Service men at present unemployed in Greater Manchester, local ex-Service Associations recently called a meeting, inviting the men and about 30 employers. This resulted in placing about 60 men in employment. Further steps are being taken, including the sending of a circular letter to all employers in the district. When this task is ended, efforts will be made to secure employment for the other unemployed ex-Service men—about 6,000 at present.

National Joint Board of Employers and Members of Staff (Electricity Supply Industry).—We have received from the Secretary of the Electrical Power Engineers' Association a pamphlet containing an account of the constitution and functions of the National Joint Board, which was formed on December 12th, 1919. A list of members of the Board is given, Ald. W. Walker being the chairman, and Mr. J. H. Parker, vice-chairman; the secretary is Mr. A. C. Tappenden, 1 and 2, Great Winchester Street, E.C. 2. In addition to Ald. Walker, the representatives of the I.M.E.A. are Ald. A. R. Jephcott, M.P., Ald. E. Vaughan, Bailie W. B. Smith, Mr. H. Faraday Proctor, and Ald. J. A. G. Beaumont; the Incorporated Association of Electrical Power Companies is represented by Messrs. R. P. Sloan, C.B.E., and W. B. Woodhouse; the Conference of the Chief Officials of the London Electric Supply Companies by Messrs. F. Bailey and F. J. Walker; and the Provincial Electric Supply Committee of the United Kingdom by Messrs. K. A. Scott-Moncrieff and J. C. Wigham. For the employés, the E.P.E.A. is represented by Messrs. J. H. Parker, W. J. Cooper, G. W. Essex, A. L. Lunn, W. A. Jones, and J. W. Thomas; and the Electricity Supply Commercial Association by Messrs. P. Burr, N. A. Chesterfield, W. Goodson, P. R. Jackson, G. R. Smith, and A. J. Squire. Meetings are held monthly. Areas for 13 District Joint Boards have been defined, covering Great Britain. The organisation is based upon that of the Whitley Councils, and the object is to secure the largest possible measure of joint action between employers and members of the staff for the safeguarding and development of the industry, and for the general improvement of conditions, with a view to promoting the best interests of all parties. The functions and procedure of the Board are fully set out in the pamphlet.

We have also received a pamphlet, dated May 12th, defining the "conditions of employment and schedule of salaries for technical engineers on the staffs of electricity supply undertakings." It is stated that the Board has been officially recognised by the Ministry of Labour as the competent authority to deal with all matters affecting salaries and conditions of employment, and that the Board has agreed to the conditions and schedule, which apply to all members of the technical staffs from "student engineer" up to and including the deputy chief official.

The conditions define the "week" as consisting of 48 hours, and cover the questions of temporarily increased responsibilities, sick leave, holidays, termination of employment, &c. The schedule is based upon plant capacity, which is closely defined; undertakings are graded in nine classes, from 1,000 to over 100,000 KW., and there are four basic grades:—(1) Deputy chief official; (3) power station superintendent; (3) mains superintendent; and (8) shift charge engineer. Intermediate grades are provided in the schedule. The total rate of salary and bonus, as at March 1st, 1920, is adopted as a basis of calculation. The salary of a shift charge engineer in the lowest size of station scheduled is to be £293 per annum, or more if he is already paid at a higher rate. The salaries are subject to re-adjustment in proportion to the official figures as to cost of living. The conditions and schedule come into operation as from May 21st, or June 1st, 1920. We print the schedule herewith. No doubt copies of these pamphlets will be in great demand from the secretary during the next week:—

SCHEDULE OF SALARIES.
PLANT CAPACITY IN KILOWATTS.

Grade.	Class A. 1,000—2,000	Class B. 2,001—4,000	Class C. 4,001—6,000	Class D 6,001—8,000	Class E. 8,001—10,000	Class F. 10,001—30,000	Class G. 30,001—50,000	Class H. 50,001—100,000	Class J. 100,001 and over.
	£	£	£	£	£	£	£	£	£
1	538	574	625	657	—	—	—	—	—
2	471	502	547	576	620	—	—	—	—
3	427	455	498	523	564	585	—	—	—
4	371	407	432	469	504	524	575	611	657
5	352	378	411	438	465	499	518	565	596
6	322	354	376	407	426	457	486	516	541
7	293	322	354	371	399	427	442	484	509
8	293	293	322	349	365	392	416	430	467
9	—	—	—	270	291	313	343	354	376
10	—	—	—	—	—	252	265	284	309

The Coal-Mining Industry.—In the May issue of the *Industrial League and Council Journal*, Mr. David Gilmour, O.B.E., general secretary of the National Democratic and Labour Party, who has seen upwards of 40 years' service in connection with the coal mining industry of Great Britain, shows how it is impossible for this industry to be developed to any appreciable extent while the seven-hour working day is in operation. He points out that in 1913 the output from British coalfields was 287 million tons, and had not the war supervened, it would to-day have been at least 300 million tons per annum. Under existing conditions it will work out at about 240 million tons, and the sad fact is, that if the field could only be brought up to 300 million tons the terrible tragedy of the gradual and persistent ever-increasing cost of living would be abated, if not eliminated altogether. Mr. Gilmour says: "My suggestion is, therefore, that it should be made worth the while of the miners to consider reverting to the eight-hours day for the period of one year on trial, and for the extra hour worked they might be paid a higher rate, as for overtime. Supposing the concession of £1 per week higher wage was granted for the extra time, this would absorb about £50,000,000 per annum of the extra £150,000,000 derived from 60 million tons additional exports, leaving a surplus of £100,000,000 yearly, which could be utilised to reduce the price of coal for industrial purposes, and bring down very considerably the charge for house coal. If this could be achieved, British trade would have such an era of prosperity as we have never previously enjoyed."

Training Ex-Service Men.—Sir Montague Barlow, Parliamentary Secretary to the Ministry of Labour, recently stated that the number of ex-Service men in training was 22 856, and the number waiting 24,880. The number already trained was 20,633, including 11,000 trained under the direction of the Ministry of Pensions.

Society for Electrical Development, U.S.A.—The above society has elected Mr. W. W. Freeman to the position of president, while the general manager, Mr. J. Wakeman, and the secretary-treasurer, Mr. James Smieton, jun., have been re-appointed.

Book Notices.—"Public Opinion in Preventive Medicine." Price 4d.; post free 5½d.—The Lady Priestley Memorial Lecture delivered by Sir George Newman, K.C.B. (Chief Medical Officer, Ministry of Health), before the National Health Society, on April 22nd, 1920, has been issued as an attractive little book of 30 pages. Everyone should read this illuminating little book, for the health and well-being of the community are of national importance. Teachers, in particular, can do much to impress upon their pupils the importance of the observance of simple and elementary precautions to avoid disease, of proper food, fresh air, and exercise. Copies of the booklet are obtainable from all booksellers and from H.M. Stationery Office.

"Controllers for Electric Motors." By H. D. James. Pp. xiv + 354; figs. 259. London: Crosby Lockwood & Son. Price 21s. net.

"The Real Wealth of Nations, or a New Civilisation and its Economic Foundations." By J. S. Hecht. Pp. viii + 350. London: G. G. Harrap & Co. Price 15s. net.

"Armature Winding." By C. Sylvester. Pp. xii + 171; figs. 129. London: S. Rentell & Co., Ltd. Price 7s. 6d. net.

"Vickers News." Vol. II, No. 16. Pp. 20.—The present number of this interesting journal includes further articles on the Cairo to the Cape and the trans-Atlantic flights, as well as a description of submarine construction at Barrow.

MESSRS W. & G. FOYLE, LTD., 121-125, Charing Cross Road, W.C. 2, have sent us a catalogue of new and second-hand technical books (39 pp.). Divided into subject-divisions, the volumes are classified under authors' names, and the published and present prices are given in each case. The subjects range from "Aeronautics" to "Brewing," and the "Electricity" division contains nearly 200 works; dates of publication, however, are omitted.

"Problems in Physical Chemistry." By E. B. R. Prideaux. Pp. xii + 294. London: Constable & Co., Ltd. Price 18s. net.

"Cheap Steam." Vol. IV, No. 3. Pp. 16. London: Ed. Bennis and Co., Ltd.—The May issue of this journal contains several articles of interest, including notes on boilers at iron and steel works, and a description of plant at the works of Messrs. W. & R. K. Lee, Ltd., Sowerby Bridge.

"The *Bulletin* of the Hydro-Electric Power Commission of Ontario." Vol. VII, No. 4. April, 1920. Pp. 32.—This issue is well illustrated, and contains a long article upon the Lincoln demand meter, and a description of the Nipigon power development.

Factory and Plant for Sale.—By direction of the Disposals Board Ministry of Munitions, the Controller of Land and Factories is offering for sale by private treaty H.M. factory and power house at Langwith, Derbyshire, the ground area of buildings cover about 145,000 ft., the power installation consisting of producer gas engines and generators, capable of developing 11,000 H.P. or 7,400 KW. Peterborough Corporation Electricity Department invites offers for one 240 cell, complete with boxes, trays and insulators. Full particulars are given in our advertisement pages to-day.

Catalogues and Lists.—MESSRS. SIEMENS BROS. & CO., LTD., of Palace Place Mansions, Kensington Court, W. 8, are distributing a new coloured showcard of their "Stannos" system of wiring, illustrating the inconspicuous nature of the work in the mansion, and drawing attention to the inexpensiveness of the system in the cottage, and to its other advantages. The simplicity of the new way as compared with the old is shown. Merchants, contractors, and traders can have copies of the showcard on application.

BRITISH BRASS FITTINGS, LTD. (Proprietors of Sperryn & Co., Chas. Joyner & Co., Ingram & Kemp, and Player & Mitchell), Moorsom Street Works, Birmingham.—Catalogue Edition B El. (157 pp.). Beautifully produced on art paper, and profusely illustrated. Dealing chiefly with electroliers and other electric lighting fittings. Fully priced.

MESSRS. ALFRED HERBERT, LTD., Coventry.—Section E 6, a 16-page illustrated, priced and dimensioned list of turret-lathe tools and accessories of all descriptions.

MESSRS. GALLOWAYS, LTD., Knott Mill Iron Works, Manchester.—Two well-produced and illustrated catalogues. "Large Gas Engines" (39 pp.), and "Uniflow Steam Engines" (17 pp.), giving detailed descriptions and specifications.

MESSRS. DONOVAN & CO., 47, Cornwall Street, Birmingham.—An illustrated and priced sheet of electrical accessories, including tumbler switches, cut-outs, bells, accumulators, insulators, jointing materials, &c.

MESSRS. W. CANNING & CO., 133-137, Great Hampton Street, Birmingham.—A booklet entitled "Linking the Past with To-day, 1785-1920." (32 pp.).—This gives a brief history of the firm, and is copiously illustrated by photographs of persons and premises.

Mr. D. C. BATE, 16, John Dalton Street, Manchester.—A four-page list setting forth the advantages of the "Bipol" accumulator, giving prices and details of working costs compared with dry batteries.

MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C. 2.—Pamphlet No. 288 describing and illustrating the "Silent Alamo" 1-KW. house lighting plant.

Liquidations and Dissolutions.—Signal Electric Co., Ltd.—Winding up voluntarily. Liquidator, Mr. G. L. Winn, c/o Bristowe & Co., Ltd., 11, Tothill Street, S.W. A meeting of creditors was held at Cannon Street Hotel on May 26th.

The following is a list of the principal creditors :—

Fisher & Ludlow, Ltd.	£603	H. K. Brownrigg, secretary (salary)	£46
W. & J. Dangerfield (judgment, including costs)	396	D. Gilson & Co.	39
Abbey Industries, Ltd. (contract amount)	218	W. E. Baker	24
Jas. Cartland & Sons, Ltd. ..	169	Leopold Norman (commission)	22
Ephraim Phillips	169	H. Drewitt, a director (expenses, &c.)	21
Drycells, Ltd. (judgment including costs)	114	S. A. Bailey, solicitor (costs, approx.)	20
R. E. H. Lovelace (including salary)	113	C. D. Flint	18
Walthamstow Urban District Council (rates)	91	Lea Bridge Gas Co. (deposit, £5, held)	14
Concordia Electric Wire Co. (judgment, including costs) ..	82	C. St. John, a director (balance of account)	18
John Matthey & Co., Ltd. (contract amount)	80		£2,880
British Insulated and Helsby Cables, Ltd.	68	Contingent Liabilities.	
		Pref. share interest, approx. ..	134
		Directors' fees, approx. ..	637
			£3,151

The loss for the period from May 31st, 1919, to May 5th, 1920, was £4,375.

Globe Electric Co., Ltd.—In this liquidation Mr. W. Osborne is acting as liquidator in place of the late Mr. G. E. Corfield. We understand that a small dividend is available.

Thacker Bell & Co.—Particulars of claims must be sent by June 30th to Messrs. Woodcock, Rylands & Parker, 15, Bloomsbury Square, W.C., solicitors to the liquidators.

The British Electrical Accessories, Ltd., Fawcett Row, Bradford.—In pursuance of Sec. 188 of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on May 21st, at the offices of Mr. F. W. Rhodes, solicitor, Cheapside, Bradford. A statement of affairs was presented by Mr. W. A. Judge, I.A., the liquidator of the company, which showed liabilities of £9,122. The assets were estimated to realise £2,281, from which had to be deducted £192 for preferential claims, leaving net assets of £2,089, or a deficiency as regarded the unsecured creditors of £7,034. The issued share capital of the company was £965, and as regarded the contributories there was a deficiency of £7,999. The liquidator stated that the company went into voluntary liquidation on May 5th of the present year, as it was unable to meet its liabilities. The following day the Sheriff attempted to enter into possession, but the liquidator's title held good, and the Sheriff retired. With regard to the unsecured liabilities, it appeared that about £4,000 was in respect of moneys advanced. During the year to April 30th, 1918, the trading resulted in a profit of rather more than £1,300, and at that date the assets were valued at £7,400. During the following 12 months there was a loss on the trading of between £400 and £500. Further accounts had been prepared covering a period of 23 months to March 31st, 1920. It was estimated that the stock at the commencement of the period was £3,981, while at the close it amounted to £1,330. The trading appeared to have resulted in the 23 months in a net loss of rather more than £5,600, while in the period the purchases aggregated £16,615, against sales of £17,425. The company was formed in May, 1914, with a nominal capital of £1,000 in £1 shares, but in view of last year the capital was increased to £15,000. The position disclosed was discussed at some length by the creditors, and eventually it was resolved to confirm the voluntary liquidation of the company, with Mr. Judge as liquidator, and a Committee of Inspection was appointed, consisting of the representatives of Messrs. Driver, Drennan & Cooper, Ltd., W. Sanders & Co., W. D. Wilson, J. H. Rushworth, and Parkin S. Booth.

Coalite, Ltd., and British Coalite Co., Ltd.—Meetings are called for June 30th, at 62, London Wall, E.C., to hear an account of the winding-up by the liquidators, Messrs. H. Bacon and J. H. Macaulay.

Endall & Sotheran, electrical, mechanical, and automobile engineers, Canal Motor Works, Canal Bridge, Church Street, St. Helens.—Mr. G. W. Endall and Mr. A. W. Sotheran have dissolved partnership. Debts will be attended to by Mr. G. W. Endall, who will continue the business at the same address, under the style of Endall & Co.

A Glasgow Exhibition.—We have received an advance prospectus of the Shipbuilding, Engineering, and Electrical Exhibition which is to be held in the Kelvin Hall, Glasgow, from November 8th to December 4th, 1920. The Exhibition is being promoted by the Corporation of Glasgow with Mr. J. M. Freer, as general manager, and applications for space are now being received. The Engineering Section will include prime movers, traction, mechanical devices, and models. The Electrical Section will cover instruments, magnetos, dynamos, and wireless apparatus. Other sections will be :—Shipbuilding, motor boats, motor cycles, and miscellaneous (including all articles applying to the foregoing trades). The prospectus contains rules and regulations, particulars of space, charges, specimens of stands, and information relating to the Kelvin Hall.

A South African Steel Corporation.—It is announced that the South African Iron and Steel Corporation, Ltd., has been registered at Cape Town, with a capital of £1,500,000.—*Times.*

Bankruptcy Proceedings.—F. Mitchell (F. Mitchell and Co.), electrical engineer, Manchester.—Discharge suspended for two years until April 27th, 1922.

E. Cloney, tramways divisional traffic superintendent, 5, Albans Road, N.W. 5.—Second dividend of 5s. in the £, payable at Carey Street, W.C.

Auction Sale.—Messrs. P. Huddleston & Co. will sell by auction, on June 7th, at Dalling Road, Hammersmith, a quantity of electrical apparatus, including dynamos, motors, generators, &c. For full particulars, see our advertisement pages to-day.

Catalogues Wanted.—Mr. E. Ames, consulting electrical engineer, 12, Whitehall Crescent, Dundee, having closed his office at the beginning of 1915 to join the B.E.F., has re-opened to continue his practice. He will be glad to receive catalogues, price lists, and any particulars from electrical manufacturers, gas and steam engineering firms.

Trade Announcements.—Mr. F. Law, electrical engineer, contractor and automobile electrician, of Grove Gardens, Headingley, Leeds, has opened premises at Tower Buildings, Ilkley, and invites manufacturers to send catalogues, lists, &c.

Buck & Hickman, Ltd., announce that their Birmingham warehouse and offices have been removed from 55, Station Street, to 23, Newton Street, Corporation Street, Birmingham.

The Jackson Electric Stove Co., Ltd., have removed their showroom and offices from Blandford Street to 143, Sloane Street, London, S.W., and all communications should be sent there.

As from May 31st the telephone number of the West End depôt (Arthur Street, New Oxford Street, W.C. 2) of Pope's Electric Lamp Co., Ltd., is changed from "Gerrard 3000" to "Gerrard 6074" (two lines). Larger stocks will be held there.

Gas Regulation Bill.—The text of the Bill recently introduced into Parliament by the President of the Board of Trade has now been published. This Bill seeks to fix the quality and price of gas, to institute penalties for deficient values, and to set up the means of making periodical tests. One of the alterations suggested in the present practice of gas undertakings is a system of charging according to the heat value of the gas supplied.

Plant for Sale.—City of Gloucester Electricity Department has for disposal one 150-kw. Bellis-Silvertown generating set, two Blake-Knowles and one Summers 10,000 lb. Scott steam-driven jet condensers. See our advertisement pages to-day.

Liverpool Corporation Electricity Supply Department has for disposal two 2,000-kw. Westinghouse-Parsons turbo-alternators with condensers, air and circulating pumps, &c. See our advertisement pages to-day.

Fire.—Early on Whit Monday morning fire broke out in the power house of Messrs. Brown's engineering works in Chapman Street, Byker, Newcastle-on-Tyne, and considerable damage was done to the installation.

Trade Openings in Italy.—The British Chamber of Commerce for Italy (Inc.), whose headquarters are at Genoa, have issued a lengthy list of openings for British firms to do business with Italian purchasers and agents.

Strike at Liverpool.—Cable jointers employed by the Liverpool Corporation are on strike for the same conditions as obtain in the building section of their Union. About 100 men are affected.

Dispute in Wimbledon Electricity Department.—According to statements issued by the E.P.E.A., a recommendation that the award of the National Joint Board for the Electricity Supply Industry of an increase of salary to station engineers of £30 per annum from January 1st, 1920, was submitted by the Electric Lighting Committee to the Wimbledon Town Council ; the matter was referred to the Staffing Committee, and on the advice of the latter, the Council rejected the recommendation. The technical staff members have, therefore, given notice that they will cease work on Monday, May 31st, unless the Corporation adopts the recommendation of the Electric Lighting Committee, and the executive council of the E.P.E.A. is prepared to support the local members.

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 25th :—Electrolytic copper bars, £109, £5 decrease ; electrolytic wire rods, £124, £5 decrease ; electrolytic H.C. wire, 1s. 4d., ¼d. decrease ; silicium bronze wire, 1s. 11¼d., ¼d. increase.

Messrs. James & Shakespeare report May 26th :—Copper bars (best selected) sheets and rods, no change. English pig-lead £41 10s., an increase of from 10s. to 30s. on the week.

Juvenile Employment.—The fourteenth annual report of the Skilled Employment and Apprenticeship Association has recently been published. Fifteen Committees were affiliated during the period covered by the report, but seven of these have announced their inability to carry on owing principally to the lack of funds and voluntary workers. The Association has been approached with a view to its taking over the management of the East London Apprenticing Fund, established some years ago by the late Lord Swaythling to provide loans for non-Jewish boys residing in the Tower Hamlets entering trades. The Association has expressed its willingness to take over this fund. The office of hon. treasurer has been taken over by Mr. Alfred P. Griffiths. The expenditure for the year exceeded the income by £65, but an appeal for funds is being made, and it is hoped to secure a number of regular subscribers. The Association was successful in finding places for 40 per cent. of the boys who applied and 47 per cent. of the girls, the same proportion as in 1918.

Turkey.—The report of the Société des Tramways et Electricité de Constantinople for the year ending June 30th, 1919, which has only just been issued, states that the year 1918 provided an exceedingly difficult one for the company owing to the scarcity of coal, and the need for tramway material, the service having for these reasons to be suspended for a certain period of time. Thanks to the influence of the Allied missions the tram fares have been greatly increased, which has considerably improved the running conditions. The demand for current is steadily increasing, but the company is not yet in a position to satisfy all the demands owing to it not being possible to promptly secure the necessary material.

New French Company.—La Société des Electrodes de la Seine is the name of a new company which has lately been formed at Paris (2 Rue Blanche), with a capital of 2,000,000 fr., to manufacture electrodes of all kinds.

Italian Company Note.—The shares in the Società Bolognese di Elettricita, of Bologna, which have hitherto been mainly held in Belgium, have been acquired by an Italian syndicate, so that the concern shall become a purely Italian undertaking.

LIGHTING AND POWER NOTES.

Birmingham.—Proposed Extensions.—The Electricity Supply Committee recommends the City Council to approve of the extension of the Nechells station at an estimated cost of £1,757,700. In 1918 authority was given for the erection of the first portion of the station and works at an estimated cost of £1,626,140. The capacity of this new plant is 30,000 KW. It was anticipated that the new station would be in commission for the winter 1920-21, and the principal contracts were placed early last year; but owing to labour disputes which prevented deliveries of material, the station will not be ready for duty before the winter of 1921-22, except possibly to a partial extent. There is at present no reserve plant. The simultaneous maximum daily load on the works during the past winter was about 63,250 KW. In the opinion of the engineer, there should be in reserve not less than 12,000 KW. to allow for normal overhaul of machinery and breakdown of plant. There are at present applications aggregating 27,000 KW., awaiting acceptance, which total would have been bigger had the department been able to deal with new business. The Committee has been advised that the Nechells station should be increased in capacity from the 30,000 KW. now in hand, to 90,000 KW. by the addition of two 15,000-KW. sets. Provisional estimates have been prepared, as follows:—Station buildings, £269,200; engine house equipment, £380,000; boiler house, £603,500; cooling towers, £81,600; switchgear, station transformers and cables, £166,900; sub-station building and equipment, £74,100; 30,000-volt trunk mains, £36,000; and 5,000-volt and low-tension mains, £146,400.

Price Increase.—Owing to the advance in the price of coal, the Electric Supply Committee has revised its rates. Making due allowance for increased output, it finds it necessary to increase the price of low-tension supplies by approximately ¼d. to ½d. per unit, according to the class of supply.

Blackpool.—Year's Working.—During the year ended March 31st last, the Corporation electricity undertaking had a total income of £80,259. Working expenses, £54,913, and £20,077 for the interest and sinking fund, left a profit of £5,269, compared with a deficit last year of £2,727. The capital outlay on the undertaking stands at £273,057, loans and sinking fund, £46,045, loans redeemed, £128,595, net indebtedness, £98,417, reserve fund nil, working balance, £2,835.

Burnley.—Prospective Price Increase.—Owing to the increase in the price of coal, it is anticipated that the cost of electricity for lighting will be ½d. per unit more after the June reading of the meters. The charges for supplies for power and tramway purposes will also be increased.

Castleblaney (Co. Monaghan).—Public Lighting.—The Urban Council has granted permission to the local electric lighting company to erect poles, wires, &c., for the electric lighting of the town.

Clones.—Public Lighting.—The Electric Light Co. has written to the Urban Council denying statements alleging wastage of electricity in public lighting, stating that the lighting was carried out in accordance with the Council's instructions. The opinion was expressed that economy was needed.

Corby.—Public Lighting Scheme.—Subject to the observance of certain conditions, the Northants County Council has decided to offer no objection to a scheme for public lighting by electricity.

Dalkeith.—Unsatisfactory Plant.—A Committee of the Town Council has inspected the power station, and is of the opinion that the plant is in an unsatisfactory condition and requires immediate attention. Several breakdowns have occurred recently, causing a great deal of inconvenience.

Darlington.—Extensions.—Extensions to the electricity undertaking, involving an expenditure of £100,000, have been approved by the Electricity Committee, to meet next winter's prospective demands, and the Finance Committee has been asked to apply for sanction to borrow this sum. The scheme provides for four additional boilers and two 5,000-KW. sets; with one set boilers to be ordered immediately.

Dublin.—Dock Troubles.—Consequent upon the refusal of dockers to handle military stores, the electric cranes and the Port Board's power station were taken over by Royal Engineers. The dock electricians threatened to call out the Corporation electricians, as a protest against the action taken by the military authorities.

East Grinstead.—Power Station Building.—The Urban District Council has decided to purchase premises with a view to adapting them for the proposed electric light works.

Gillingham.—Wages.—Threatened with a strike, the Council has agreed to increase the wages of electrical operatives.

Hamilton.—Electricity Supply.—Subject to a satisfactory report from the consulting engineers, the Town Council has approved of an application by Edmundsons, Ltd., to expend £5,250 on the installation of a 500-KW. rotary converter, &c., and £100 for the laying of a new feeder to Clydesdale Street.

Hatfield.—Mains Extensions Approved.—The Commissioners have informed the District Council that they have informally approved the proposal of the North Metropolitan Electric Power Distribution Co. to lay mains between St. Albans and Hatfield.

Kingstown (Co. Dublin).—Electricity Supply.—The Urban Council has received a letter from the Law Agent stating that an electricity supply might be obtained from the Dublin Corporation or the Dublin United (Electric) Tramways Co. without the erection of a special power station.

Kingston-on-Thames.—Loans.—The Town Council has applied for loans of £6,000 for two new chain-grate stokers, superheaters, and a steel stack with induced-draught plant; and £9,200 for H.T. and L.T. mains and the cost of converting consumers' plant for a three-phase supply.

Lanark.—Electric Light Scheme.—The Town Council has decided that an expert shall be consulted respecting the suggested electric lighting scheme for the town.

Liverpool.—Special Rates.—The Corporation has approved an agreement for the supply of electrical energy for trade purposes to be charged at power rates.

Navan.—Electric Light Scheme.—Mr. L. J. Lawless, consulting electrical engineer, reporting to the Council on a scheme for electric lighting of the town, estimates the cost at £10,750, plus £1,713 working expenses, and revenue at £2,350. The charge to private consumers to be 1s. per unit. The Council has resolved to ask another expert to furnish a separate report.

Perth.—Extensions.—The Town Council is communicating with the Electricity Commissioners with regard to an extension of plant at the power station and the construction of a railway siding.

Price and Supply of Electricity.—In the House of Commons, Mr. W. H. Sugden asked the Minister of Transport if he would say when he hoped to have a definite economical price fixed and increased electrical power at the disposal of industrial undertakings, bearing in mind the fact that the first portion of the cycle of trade activity had now been entered upon, and could assurances be given that some definite portion of the scheme would be operative before the trade activity passed. Mr. Neal (Parliamentary Secretary to the Ministry of Transport) said there would be a fixed economical price, which would be of general application. The fixing of the price or prices would depend on the operations of the new authorities to be set up under the Electricity (Supply) Act of last session. The Electricity Commissioners were engaged on work preliminary to the determination of the new districts, in accordance with the provisions of the Act. It would then be for existing electrical undertakings, local authorities, and others in each district to formulate schemes for submission to the Commissioners embodying improvements in the supply of electricity in such districts. The Commissioners were fully aware of the importance of expediting the work of reorganisation under the Act, and had already made substantial progress.—*Manchester Guardian.*

South Shields.—Training Electricians.—A scheme formulated by the Electricity Committee to train boys in the municipal station as electricians was adopted by the Town Council. Trainees will receive no payment for the first six months, but after that time a scale rising from 10s. to £2 per week will be put into force. A proposal for training ex-officers in this work was referred back to the Committee for further report.

Warrington.—Extensions.—Official sanction has been received to the expenditure of £183,000 on extensions to the electricity works.

Wrexham.—Extensions.—Application has been made by the Town Council for sanction to borrow £17,000 for the extension of the electricity undertaking. It is intended to provide a new boiler, complete with stoker, coal bunkers, foundations, pumps, &c., at a cost of £11,350; economisers, flues, &c., £2,230; buildings, £2,000; and water-softener, £1,260.

Wigton.—Electricity Supply.—The Urban District Council has asked the Carlisle Town Council the price at which electricity can be supplied to the district.

York.—Time Extension.—The Minister of Transport has extended the time of the York Electric Lighting (Extension) Order, 1914, until April 30th, 1921, for the extension of mains, &c.

TRAMWAY AND RAILWAY NOTES.

Australia.—Wage Demand.—Railway and tramway men in Victoria and New South Wales are demanding double wages during the visit of the Prince of Wales.—*The Times.*

Blackpool.—Year's Working.—The Corporation tramways made a profit during the financialyear ended March 31st last, of £15,583, compared with £30,052 the preceding year. The receipts were £186,475, as against £140,929, but the working expenses totalled £147,770, compared with £90,033 for the previous period.

Bradford.—Proposed Fare Increase.—At a special meeting of the Tramways Committee last week, Mr. R. H. Wilkinson, the manager of the department, presented a report concerning the proposal to increase the fares. Additional information is, however, required as to whether a scheme of short stages for a penny and at the same time increasing the 1½d. fare to 2d. is not practicable, and the question is to be further discussed.

Brazil.—Railway Electrification.—The contract for the electrification of the Paulista Railway Co.'s line between Jundiaby and Campinas, has been secured by the International General Electric Co. The total cost is estimated at $2,000,000, the line being 28 miles in length, double track. The rolling stock is to consist of 12 geared type 3,000-volt D.C. locomotives, four passenger and eight freight engines. The power will be supplied by the Sao Paulo Light and Power Co. at 88,000 volts, 60 cycles. Extension of electrification as far as San Carlos is contemplated, which will make a total length of 128 miles.

Continental.—Italy.—It has been decided to extend the electrification of certain lines in the north-west, especially in Liguria, Piedmont, and Lombardy. The three-phase system is used on the lines already electrified in this region. The following are the sections which the Railway Administration has been authorised to electrify:—Turin-Alexandria-Rouco, 137 km.; Voghera-Novi, 35 km.; Alexandria-Tortona, 22 km.; Asti-Ovada-Sampierdurena, 101 km.; Trofarello-Fossano-Mondovi-Ceva, 80 km.; Bussoleno-Turin, 45 km.; total, 420 km. A sum of 280 million lire has been earmarked for the work, which will be crrried out by the State Railway Department. A further 209 km., comprising Turin-Milan and Milan-Voghera will be electrified. This part of the work is being put to tender by private industry. The cost will be some 60 million lire.—*L'Industria.*

Doncaster.—Inadequate Service.—Some very caustic comments were made at the last meeting of the Bentley District Council anent the dilatory manner in which the village was being served with tramways. The track is partly up, owing to repairs, and only one car has been running for the past three weeks. The Council decided to lodge a complaint with the Ministry of Transport.

Liverpool Electric Signalling.—On the Mersey Electric Railway it is intended to introduce new automatic signalling, so as to concentrate a larger volume of traffic in the busy hours of the day. The system will be similar to that in use on the underground railways in London. The contract for the work has been placed, and it is expected that the new installation, which will be of the most modern type, will be completed by October next in time for the heavy winter traffic, which usually commences about that time. The power for operating the apparatus will be supplied by special sets installed at the power stations, and will be independent of the main supply for operating the trains.

Huddersfield.—Coal Haulage.—It was reported at a recent Council meeting that £1,687 had been received for the haulage of coal along the tramlines to mills at Lindley and Outlane. The loss of revenue in consequence of the recent strike of tramway employés was £7,536.

India.—Tramway Reconstruction.—The Bombay Electric Supply and Tramways Co. has approved a scheme for the reconstruction of the company, and it has been resolved to raise the capital from £1,430,000 to £1,680,000.—*Engineer.*

Johannesburg.—Overhanging Trees.—Unusual circumstances attended the payment by Johannesburg Town Council of £2,000 to a man who lost the sight of an eye owing to an accident while a passenger on a tramway car. The mishap was due to a tree brushing against the top deck and striking him as he sat in his seat. The Tramways Committee reported that it had been advised that the other eye was affected, and on an examination being made, its medical officer reported that the sight of the other eye was limited to five-ninths of the normal. The claim originally was for £4,500, but the passenger's solicitor offered to settle, without prejudice, for the sum already mentioned. That amount was voted "in full and final settlement of the claim." The case is not without interest for other tramway and also omnibus undertakings. It is the duty of owners of trees to keep them from becoming a danger to traffic. In case of neglect the local authority can demand a removal of the obstruction, and, if necessary, carry out the operation. Such action has been taken in the metropolitan district and elsewhere at the request of the London General Omnibus Co. There have been occasions when in cases of delay the company's employés have been seen undertaking the task, the men working from the top of an omnibus. In the case of lamp-posts situated too near the edge of the kerb, disputes have arisen between a local authority and the company. While the former has attributed collisions to the overhanging of the top deck, the company has complained that the road has too pronounced a camber. This is a matter that ought to come under the cognisance of the Minister of Transport, at least on main thoroughfares.—*Tramway and Railway World.*

Leeds.—Reserve Fund.—The Tramways Committee recommends that in future any surplus receipts from that department shall be paid into the tramway reserve fund, authorised by the Act of 1905, and that the fund shall accumulate till £100,000 is reached. Previously the reserve fund was fixed at £25,000. In 1919 the department relieved the rates to the extent of £90,000. Last year's working showed a net surplus of £83,757.

Proposed Fare Increase.—The proposal to increase the tramway fares to 1d. a mile is to be again brought before the full Council for discussion, despite the fact that a similar proposal was negatived by the Council about six weeks ago. It is stated on the authority of the chairman of the Tramways Committee (Alderman R. A. Smithson) that the department is losing £300 a day on the present fares.

Llanelly.—Strike Ended.—The tramway workers have resumed work, after being on strike for three weeks.

London.—Higher Fares.—At a recent meeting of the L.C.C., the chairman of the Highways Committee foreshadowed further increases in fares in the near future. A proposal to reserve cars for women only was not considered desirable.

Oxford.—Strike.—The employés of the Oxford Electric Tramway Co. (which runs an omnibus service in the neighbourhood) came out on strike for higher wages on May 19th, and no vehicles were running. The city is very full of visitors, and the stoppage caused great inconvenience.—*The Times.*

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—New Wireless Stations.—According to the *Review of the River Plate*, the wireless stations are inadequate for a general public service as they are practically constantly occupied in the transmission of official dispatches. They are, therefore, to be augmented, and the wireless telegraph division and the Ministry of Marine has formulated a plan which has been approved by the Government, and a naval officer is to come to England to make the necessary acquisitions. The project comprises the erection of three stations at the Patagonian ports of Gayman, Rawson, and Puerto Gallegos, in addition to one at Buenos Aires. These stations will be capable of transmitting over a distance of 2,000 km. under all conditions. It is intended later to supplement them with four other stations of 800-km. capacity situated at Corrientes, Puerto Militar, Comodoro Rivadavia, and Ushuaia.

Cable Repairs.—The work of repairing the Stornoway, Castlebay, and Skye cables is being carried out quickly. The services of the Lochboisdale and Tobermory wireless stations are no longer necessary, and the repairs to the Stornoway and Poolewe cables would have been completed had the weather remained favourable.

Canada.—Telegraph Rates.—According to the *Times*, a ruling of the Railway Commission permits the increase of rates on telegrams in Eastern Canada by 32 per cent., and in Western Canada by 20 per cent. This ruling does not, however, apply to Press messages.

United States.—Wireless Telephony.—The *Telephone Engineer* announces that tests in the U.S.A. have proved that it is possible to communicate by wireless telephony over a distance of 1,500 miles, using a generator having a capacity of only ½ KW. The De Forest Radio Co., of New York, enlisted the aid of members of the American Radio Relay League in its experiments. Tests, which commenced in February last, were carried out nightly with many members of the League listening in, and Mr. R. F. Gowan, engineer to the De Forest Co., at the New York end, and Mr. R. H. G. Matthews, vice-president of the League, at the receiving station at Chicago. Eventually communication was established between the two cities, a distance of 750 miles, with the power mentioned above. Later, letters were received from observers at Topeka, Kas., 1,500 miles away; Valley City, N.D.; Battle Creek, Mich.; and Gaffney, S.C., announcing that they also had heard the conversation.

The U.S.A. Department of the Interior has equipped its rangers in the forests of the West with small wireless telephone sets having a small range to facilitate communication.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.— MELBOURNE.—May 31st. Victorian Railways Department. Four 4,500-KW., 1,500-volt traction converter sets, and eight 1,000-KW., 1,500-volt ditto. (April 30th.)

SYDNEY. — August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

PERTH. — July 14th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 674.

June 16th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 680. (May 14th.)

ADELAIDE.—June 23rd. P.M.G.'s Department. Telephone parts (schedule 541). (May 21st.)

Barnes.—June 7th. Urban District Council Electricity Department. Coal-handling plant and overhead steel or ferro-concrete bunkers. (May 14th.)

Belgium.—June 2nd. La Société Nationale de Chemins de Fer Vicinaux, 48, Rue Montoyer, Brussels. Installation of the overhead electric equipment of the Namur La Citadelle line and branches. Particulars from the department of the Services Electriques at the above address.

July 9th. Brussels Municipal Authorities. A turbo-alternator at the generating station on the Quai des Usines, Laeken. Specification 2 francs and drawings 1½ francs, from the Hotel de Ville, 15, Rue des Augustins, Brussels.

Carlisle.—June 25th. Electricity Department. One 3,000-KW. turbo-alternator and condensing plant. (See this issue.)

Dublin.— June 7th. Electricity Supply Committee. 12 months' supply of single-phase and three-phase meters.

June 1st. Electricity Supply Committee. 22 direct-current magazine flame arc lamps. (May 21st.)

June 10th. Electricity Supply Committee. Feed pump, tanks, pipework, &c., for Pigeon House generating station. (See this issue.)

Dundalk.—June 15th. Urban District Council. Electricity Department. 750 yd., L.T., 3-core, paper-insulated, lead-covered and armoured cable; disconnecting boxes (pavement type) and joint boxes. (See this issue.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

Grimsby.—June 7th. Electricity Department. E.H.T. cables and pilot cables (specification No. 146). (See this issue.)

Ince-in-Makerfield.—June 15th. Urban District Council. Waterworks Department. Motor-driven pumping sets; cables; alterations to winding engine from steam to electric drive; switchgear. (See this issue.)

Leeds.—June 14th. Electricity Department. 12,000-KW. steam turbine, alternator and condensing plant. (May 14th.)

London.—HACKNEY.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-KW. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-KW. coupler panels; one 10,000-KW. generator panel; six 2,000-KW. and one 4,000-KW. feeder panels. (May 7th.)

BETHNAL GREEN.—June 7th. Electricity Supply Department. Two 500-K.V.A. transformers; one E.H.T. and one L.T. panel; L.T. feeder cables; section pillars and road work. (May 21st.)

ST. PANCRAS.—June 10th. Electricity Department. 45,000 tons steam coal for the Regent's Park and King's Road electricity stations. Electricity Department, 57, Pratt Street, Camden Town, N.W.

WIMBLEDON.—June 12th. Electric Lighting Committee. Two boilers, with mechanical stokers, induced-draught fan and motor, pipework, steel chimney, &c. (See this issue.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Salford.—June 5th. Electricity Department. 12 months' supply of D.C. and A.C. meters. (May 21st.)

Southampton. — June 14th. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (See this issue.)

Spain.—June 2nd. Gijon-Musel Harbour authorities. Three 3-ton electric cranes. Tenders to the Junta de Obras del Puerto de Gijon-Musel.

Warrington.—June 15th. Electricity and Tramways Committee. Motors and transformers. (See this issue.)

CLOSED.

Government Contracts.—The following Government contracts were placed during April, 1920 :—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Conduit tubing and accessories.—Barton & Sons, Ltd.; Oriental Tube Co., Ltd.
Electrical plant.—British Thomson-Houston Co., Ltd.
Electric lighting.—Foote & Milne, Ltd.
Reconstruction of motor-generators, &c.—British Electric Plant Co., Ltd.
Turbo-generator armature.—Metropolitan-Vickers Electrical Co., Ltd.

MINISTRY OF MUNITIONS.

Armoured cable.—Siemens Bros. & Co., Ltd.

INDIA OFFICE: STORE DEPARTMENT.

Accumulator battery.—Chloride Electrical Storage Co., Ltd.
Cells.—Siemens Bros. & Co., Ltd.
Creed printers.—Creed & Co., Ltd.
Insulator cups.—Bullers, Ltd.
Generating sets.—Lancashire Dynamo & Motor Co.
Insulators.—Bullers, Ltd.
X-ray plates.—Kodak, Ltd.
Insulator stalks.—Bullers, Ltd.
Switchboard.—Bertram Thomas, Ltd.
Desk telephone sets.—Peel-Conner Telephone Works, Ltd.
Coolidge tubes.—British Thomson-Houston Co., Ltd.

POST OFFICE.

Laying conduits.—London-York (Sections 1 and 2): W. Dobson; Nottingham-Derby (Sections 2 and 3): W. Dobson; Glasgow (South): A. Duncan; Newcastle-on-Tyne (Sections 1, 2, 4 and 6): W. Turner (Ardwick), Ltd.; Leeds-Harrogate, Leeds-York (Section 1): W. Ellis. London-Bristol-Newport (South Midland, Section 2): J. F. Hodge & Co.; Nottingham-Derby (Section 1): Kettle & Son; London-Southampton (Section 2): Hodge Bros. (Contractors), Ltd.; Lee (High Road): J. Mowlem & Co., Ltd.; Toll Exchange area: J. Mowlem & Co., Ltd.; Penge-Anerley: W. H. Wheeler & Co., Ltd.; Brompton Road, S.W.: O. C. Summers; Nottingham-Derby (Section 4): Chandler Bros.
Manufacture, supply, drawing-in and jointing cable.—London-Southampton (London-Guildford section): Callender's Cable & Construction Co., Ltd.
Repairing battery, East London Telephone Exchange: Hart Accumulator Co., Ltd.
Runaway, ash hoist, overhead travelling crane and geared trolley.—Mount Pleasant E.C. Boiler House and Sub-station: H. Morris, Ltd.
Telephone exchange equipment.—Port Talbot, New Cross, Bradford (central), Crosby, Trafford Park: Western Electric Co., Ltd.; Northwich: Automatic Telephone Manufacturing Co., Ltd.
Sub-contractors for batteries.—Chloride Electrical Storage Co., Ltd.
Starting switch and field rheostat.—Crompton & Co.
Switches, D.P., and measuring instruments.—Park Royal Engineering Co., Ltd.
Fuse switch.—Berry's Electric Co.
Charging rheostat.—Geipel & Co.
Circuit-breaker.—Whipp & Bourne.
Scarborough Telephone Exchange equipment.—Siemens Bros. & Co., Ltd.
Sub-contractors for accumulators.—Tudor Accumulator Co., Ltd.
Charging machine.—English Electric Co., Ltd.
Ringing machine.—Crompton & Co., Ltd.
Knife and meter switches, starting switches, field regulator (switchgear on power board).—English Electric Co., Ltd.
Indicating meters.—Everett, Edgcumbe & Co., Ltd.
Circuit-breaker for generator.—I.T.E. Electric Co.
Fuse switch (switchgear on power board).—Berry's Electric Co.
Protective apparatus.—Siemens Bros. & Co., Ltd.; International Electric Co., Ltd.
Telegraph apparatus.—W. Sanders & Co.
Telephone apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.
Terminal blocks.—Edison Swan Electric Co., Ltd.
Bolts for insulator spindles.—Horton & Son; Portland Bolt and Nut Co., Ltd.
Iron brackets.—D. Willetts, Ltd.
Telegraph and telephone cable.—British I. & H. Cables, Ltd.; Enfield Ediswan Cable Works, Ltd.; Fuller's United Electric Works, Ltd.; Hackbridge Cable Co., Ltd.; Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Union Cable Co., Ltd.
Artificial cables.—H. W. Sullivan.
Dry cells.—Siemens Bros. & Co., Ltd.
Leclanche cells.—Siemens Bros. & Co., Ltd.
Secondary cells.—Van Raden & Co., Ltd.
Joint box channels.—Bailey Pegg & Co., Ltd.; Falkirk Iron Co., Ltd.; McDowall, Steven & Co., Ltd.
Stoneware ducts.—Donington Sanitary Pipe and Firebrick Co., Ltd.; G. Jennings; Robinson & Dowler, Ltd.; Stanley Bros., Ltd.; J. H. Turner & Lesney, Ltd.
Stoneware Leclanche jars.—J. Bourne & Sons, Ltd.
Glow lamps.—British Thomson-Houston Co., Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.
Earth plates.—Walls, Ltd.
Insulator spindles.—T. W. Leach, Ltd.; Bayliss, Jones & Bayliss, Ltd.
Swivel stays.—Bullers, Ltd.
Voltoids.—Brunner, Mond & Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.
Enamelled, &c., copper wire.—London Electric Wire Co. & Smiths, Ltd.
H.D. copper wire.—T. Bolton & Sons, Ltd.; British I. & H. Cables, Ltd.; Elliott's Metal Works, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Son & Mapplebeck, Ltd.
Tinned copper wire.—T. Bolton & Sons, Ltd.
Switchboard wire.—Macintosh Cable Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering work, &c.—Birmingham Hostels electric storage battery: Premier Accumulator Co., Ltd.; Hampstead Research Institute switchboard: Drake & Gorham, Ltd.

CROWN AGENTS FOR THE COLONIES.

Aerial cable.—Callender's Cable & Construction Co., Ltd.
Copper cable conductors.—Siemens Bros. & Co., Ltd.
Electrical fittings.—General Electric Co., Ltd.
Telegraph ironwork and line material.—Siemens Bros. & Co., Ltd.

Shrewsbury.—
Two new economisers for the generating station, £1,155.—Messrs. Lowcock.

Southend-on-Sea.—Town Council :—
24 40-H.P. traction motors, £6,720; and 12 electric brakes and equipment, £1,800.—English Electric Co., Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 28th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "Two Years as an Engineer in the Grand Fleet," by Mr. A. Arnold.

(South-Western Local Section).—Friday, May 28th. At the Public Library, Plymouth. At 7.30 p.m. Inaugural meeting.

Royal Society of Arts.—Friday, May 28th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Lignite," by Prof. W. A. Bone, F.R.S.

Friday, June 4th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "The Oil Resources of the British Empire," by Prof. Sir J. Cadman.

Electrical Power Engineers' Association (Southern Division, London Industrial Section).—Friday, May 28th. At Anderton's Hotel, Fleet Street. At 7.30 p.m. Open meeting.

Physical Society of London.—Friday, May 28th. At the Imperial College of Science, South Kensington. At 5 p.m. Discussion on "X-Ray Spectra," to be opened by the President, Sir W. H. Bragg, F.R.S.

Royal Institution of Great Britain.—Saturday, May 29th. At Albemarle Street, W. At 3 p.m. Tyndall lecture on "Recent Revolutions in Physical Science: (1) the Theory of Relativity," by Prof. J. H. Jeans, F.R.S.

North of England Institute of Mining and Mechanical Engineers.—Saturday, May 29th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. General meeting.

Chief Technical Assistants' Association.—Thursday, June 3rd. At Anderton's Hotel, Fleet Street, E.C. At 7 p.m. Paper on "Maintenance of Tramway Equipment," by Messrs. Manley & Stanley.

NOTES.

Parliamentary.—On May 17th the Tramways (Temporary Increase of Charges) Bill was read a third time and was passed.

Electric Vehicle Charging Garages.—We are informed by the chairman and hon. secretary of the Electric Vehicle Committee, Mr. Frank Ayton, that the Electricity Commissioners are prepared to consider applications from local authorities, being authorised undertakers, for sanction to loans for the purpose of providing public electric vehicle-charging garages and the equipment thereof. Provisional sanction has already been given to the borrowing by the Ipswich Corporation of the sum of £4,000 for this purpose.

Brevities.—Work varies inversely as the square of the talk.

The torque of a rotor gets things done; the rot of some talkers doesn't.

If you want to lose your good name, have it stamped on your two-foot rule.

He that will not be ruled by the rudder will be wrecked by the rocks.

There are no half measures about automatic plants; they are either automatic or autoblazes.

Increase of resistance means decrease of current. Some fellows go through life as if this were the last word. What's the matter with increasing the pressure and getting a move on?—"BEOLA," in the *Journal*, N.A.S.E.

The Nobel Prizes.—The distribution of the 1918 and 1919 Nobel prizes will take place in Stockholm on June 1st. Among those who will be present are Prof. Sir W. H. Bragg and his son, Prof. W. J. Bragg, and Prof. Charles G. Barkla, of Edinburgh.

Inquiry.—Makers of the "Hough" watertight ship fitting are asked for.

The Electricity Supply Amending Bill.—According to *The Times* the Electrical and Allied Trades' Section of the London Chamber of Commerce has passed a resolution expressing alarm and regret at the introduction of the Bill for the purpose of reviving the "objectionable clauses" which were dropped from the Electricity (Supply) Act of 1919, largely at the instance of associations (including that chamber) representative of consumers and producers alike.

The Metric System in U.S.A.—In the May issue of the *Journal* of the American Society of Mechanical Engineers, a resolution of the Council is recorded, stating, in view of the publication of articles to the effect that the Society is opposed to the metric system, that the Society has not taken any stand either for or against the metric system. This declaration is important, seeing that the Society has repeatedly been represented as the leading opponent to the adoption of the metric system in the United States.

Oil-Electric Locomotives.—According to *The Times*, oil-electric locomotives have been tried on the French Nord Railway with great success, and it is now proposed to make a more general use of such engines owing to their practicability in case of strikes.

Educational.—Prince Arthur of Connaught has received two important donations to the University College Engineering Fund from America, namely, £500 from Mr. J. Pierpont Morgan, and £500 from Mr. E. R. Stettinius. Other donations received recently include Igranic Electric Co., Ltd, £50; and a promise of apparatus to the value of £50 from Messrs. Nalder Bros. & Thompson, Ltd. The total of the fund up to date amounts to £32,375.

At a recent conference of technical teachers, it was resolved to press for the formation of a Burnham Committee to deal with salaries of teachers in technical institutions. An immediate increase is being asked for, to bring salaries up to the level which would have been reached if the Civil Service bonuses had been awarded.

Legal.—CORK.—At the Fermoy (Co. Cork) Quarter Sessions on June 7th, the Recorder of Cork will have before him for hearing the claim of the Postmaster-General for £230 compensation for the cutting of many telegraph and telephone wires in several parts of East Cork on Saturday night, May 8th.

Judgment was given by Sheriff Substitute Macleod at the Sheriff Court, Edinburgh, in the case in which James Cameron, electrician, 37, Saughton Hall Drive, Edinburgh, was charged with having, between February 11th and 23rd last, resetted in his premises at Haymarket Terrace, three electric motor engines. Evidence had been heard last week. His Lordship, in finding the charge proved, said that accused had yielded to temptation under very special circumstances. It was thus an exceptional case, and therefore he dealt with it by imposing a fine instead of a term of imprisonment. But the fine must be a substantial one of £25.

Turbine Steam Consumption.—In discussing Mr. W. T. Lane's recent paper on "Fuel Economy in Power Production [or Utilisation of Waste Heat]" before the South Wales Institute of Engineers, Prof. F. Bacon said that the figures which the author gave of a turbine of 5,000 KW. capacity, with a guaranteed steam consumption of 10·2 lb. per KW.-hour, were very interesting, and presumably they were based on a turbine which was on order for the Powell Duffryn Co. This showed that South Wales was to possess about the most economical steam turbine yet produced. Particulars had been recently published of the super-power station at Rotherham, and they learned of a Parsons turbine there of more than double the size of that mentioned by Mr. Lane, namely, of 12 500-KW. capacity, with a guaranteed steam consumption of 11·1 lb. per KW.-hour. Then there was a 30,000-KW. turbo-generator being erected at the same station, with a guaranteed steam consumption of 11·1 lb. per KW.-hour. Thus, in South Wales they had a turbine only one-sixth the size with a consumption of 1 lb. less of steam per KW.-hour. No doubt the explanation was that in this case they were making use of exceptional steam pressures and exceptional super-heat—he imagined not less than 350 lb. per sq. in., and temperatures running up to 750° F., which must be getting near the limit of what could be attained with steel castings and steam valves such as were now available.

The Electrical Trades Benevolent Institution.—The report of the committee and accounts for the year 1919 have come to hand; the volume includes the report of the annual general meeting, 1919, and the festival held on November 12th, 1919, as well as a list of governors, members, subscribers and donors, and the rules. The report and accounts for the year were presented at the annual general meeting, of which we gave a report on p. 552 of our issue of April 30th, 1920. A special meeting will be held on June 7th at 2.30 p.m., at the secretary's office, 36-38, Kingsway, to confirm a resolution altering Rule 17 which was passed at the annual meeting.

Appointments Vacant.—Technical assistant (£804) for the London County Council Fire Brigade Department; meter repairer (mechanician) (45s. + 33s. 6d. + 12½ per cent.) for the Borough of Lancaster Electricity Department; lecturer in electrotechnics (£390—£465) for the Salt River Technical Institute, Cape Town; temporary technical assistant for the Chesterfield Corporation Electricity and Tramways Department; charge engineer (£3 + E.P.E.A. award) for the Southwark Borough Council Electricity Department; power-station engineer (£300 + £120 + 20 per cent.) for the Woolwich Borough Council Electricity Department; plumber-jointer (91s.) for the Rhyl U.D.C. Electricity Department. See our advertising pages to-day.

A general manager and engineer is required for the Tees-side Railless Traction Board at Middlesbrough (£500).

New Method of Erecting Poles.—An interesting method of erecting poles by means of a combination tractor and earth-boring machine, which digs a hole and sets the pole in about eight minutes, is mentioned in the *Telephone Engineer*. The earth-boring machine is mounted on the frame of the tractor, which carries it over any obstacles that may be encountered in an ordinary day's travel. The poles, cross arms and insulators, &c., are all assembled beforehand, and when the spot at which the pole to be erected is reached, the power from the Monarch tractor engine is switched to the earth-boring machine. This, in reality, is a giant auger which will bore a hole in the ground any size from 2 to 30 in. in diameter, and as deep as 8 ft. When the hole is bored, the steel tower in which the auger is contained is used as a crane to lift the pole and set it in position. The whole operation is remarkably expeditious, and when once it is seen at work, the manual process ordinarily used seems incredibly slow and awkward.

The Educational Kinema.—The Dean of Worcester, speaking at a lecture, said that he considered the kinema of the greatest educational value, and he was in negotiation with the lessee of a leading kinema in Worcester to take it over for a week, when he intended to have children's days, and exhibitions which would elevate and educate adults.

Municipalisation.—Although the methods of municipalities on this side of the Atlantic are often severely criticised, it is, perhaps, comforting to reflect that public opinion on this subject

The Influence of the Art of Millet on the Modern Municipal Street Gang.

in the United States of America, justly or otherwise, is much stronger, as the picture reproduced above will testify. This is taken from the National Electric Light Association *Bulletin*, which reproduced it from the well-known *New York Tribune*.

Alumina as a Refractory.—In *Technique Moderne* (Vol. 12, No. 3) a note on the use of products of aluminium as refractory materials is printed. While these products are not suitable for large furnaces, they serve admirably for laboratory furnaces, provided that they are prepared by the process indicated in the note, for temperatures up to 1,600° C.

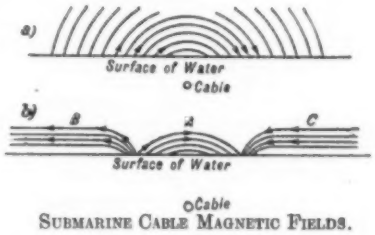
The New Motor Taxes.—The petrol world is greatly exercised over the change from a petrol tax to a vehicle tax based on horse-power or weight. The special committee appointed by the Minister of Transport to report on the matter decided to bring in all power-propelled vehicles, on a basis which would afford an approximation to the distinctive use of the road. Motor cycles are to be assessed according to category, private motor cars on horse-power, hackney vehicles on seating capacity, and commercial and agricultural vehicles on unladen weight. The new scale will not come into force until January 1st, 1921. Some editorial reflections on the matter in the current issue of the *Electric Vehicle* will not be out of place; they are:—

"So far as electric vehicles are concerned, there is little ground for complaint. The committee has, we imagine, not overlooked the fact that battery-propelled vehicles, thanks to their easy running and smooth speed control, are much less severe on road surfaces than other vehicles equivalent in weight and average speed. On this and other grounds the weight of the accumulators is to be excluded from the vehicles in ascertaining the unladen weight of commercial vehicles.

"The minimum tax for private cars is £6, and electrically-propelled cars of this class pay only this amount. Electrically or mechanically-propelled bath-chairs or other vehicles for invalids, not exceeding 5 cwt. in weight inclusive, pay five shillings. In this case the batteries are included. For commercial goods vehicles the rate proposed is from £10 for vehicles not exceeding 12 cwt. unladen weight up to £30 for vehicles over 4 tons unladen weight. Hackney vehicles (other than tramcars, which are to be chargeable as hackney carriages as at present) are to pay according to seating capacity from £15 for a vehicle with a seating capacity from one to five passengers to £84 for a vehicle with a seating capacity of over 32.

"On motor scooters and other motor assisted cycles and motor cycles, up to and including 200 lb. in weight, the tax is thirty shillings, and above that limit it is £3, with an extra £1 on all motor cycles with the right to draw a trailer or side car. These taxes seem rather heavy. A tax of 30s. on a scooter propelled by batteries is manifestly onerous, and a similar observation may be made in the case of a light car propelled electrically. If it is a three-wheeler, it will pay £4; if it is a four-wheeler, it will pay £6, no matter how trifling its efficiency as a destroyer of roads. The application of battery traction to scooters and other small vehicles is as yet in an experimental condition, but when development does occur there ought to be some concession to the electric method, on account of its reduced wear and tear on the roads. The low rating of motor bath-chairs and other vehicles for invalids is welcome, but it rather throws into relief the fact that an electric chair, similar to those used at American exhibitions, would be taxed at the rate of £4 a year, as if it were a high-speed vehicle instead of a handy means of progression at a walking pace. And when some bright genius uses a small battery to push along a perambulator he will pay handsomely for the privilege. Another form of electric traction which the committee has overlooked is the industrial truck. The great majority of industrial trucks are used on private ground—in factories, railway stations, docks, and so on—but in a few cases, notably that of the B.S.A. works in Birmingham, they traverse the public streets on their way to and from various departments. In the latter instance they bear the usual identification plates, and are otherwise regulated as motor vehicles, but it would be absurd to class them, for taxation on behalf of road wear, on the same basis as the ordinary commercial vehicle. One has only to look down the classified list of vehicles in the committee's report to realise that nobody contemplated the possibility of factory trucks using the highway occasionally in the execution of their duty. Presumably they would come under the classification of "commercial goods vehicles," and would pay a minimum of £12—£10 for the truck itself and £2 extra for the right to draw a trailer. This is a preposterous tax for a means of factory transport which involves only a trifling use of the road, and is of a totally different character from the ordinary commercial vehicle. The simplest way out of the difficulty is to exempt electric industrial trucks from taxation or to impose a merely nominal rate. We may note that locomotive ploughing engines, agricultural tractors not exceeding 5 tons unladen weight, or other agricultural engines drawing necessary gear, threshing appliances, farming implements, or supplies of fuel or water shall pay a duty of 5s. per annum only, if not used on roads for other haulage work. The addition of electric industrial trucks to this category would remove the anomaly into which the committee has fallen."

Submarine Cable Magnetic Fields.—Some experiments described in *E.T.Z.* were carried out in 1918 by the Under Water Signalling Section of the Kiel Torpedo Inspection Department, and consisted in an investigation of the magnetic field in the neighbourhood of the surface of the water covering a cable carrying alternating currents of frequencies of 50, 500, and 1,000 cycles. The current was fed in at one end by the generator and out at the other end through an earth connection, and was usually 2 amps. The field was explored by observers in boats equipped with search coils connected to amplifiers and telephones, and in the case of 50-cycle experiments the oscillations were rendered audible by a method that is not disclosed. At 50 cycles the field above the cable was of the distribution shown at (*a*) below, and just as one would expect, but at 500 and 1,000 cycles the lines of force took the form of (*b*) of the figure. It will be seen that the lines A represent the circular field due to the current in the cable, and the lines in the zones B and C are produced by eddy currents induced in the water. The double change of

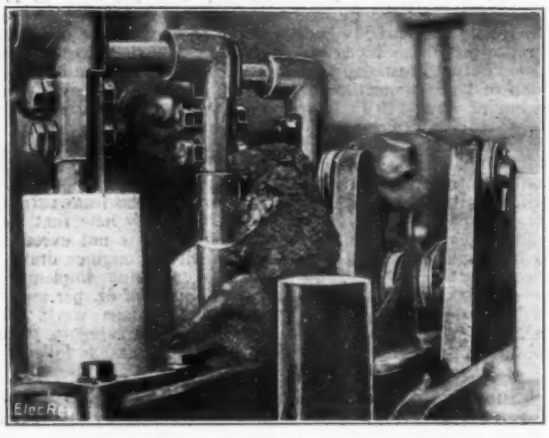


Submarine Cable Magnetic Fields.

direction of the field at the junctions of the zones A and B and A and C was corroborated by various tests. If iron ships are used, it is found that the lines of force follow the direction of the sides of the ship and run at right angles to the axis of the ship—that is to say, the ship becomes a conductor of the current, which is absorbs from the water. The intensity of the field decreases inversely as the square of the distance from the cable. Proceeding along the cable from the end that is fed by the generator, both the current and the magnetic field decreased according to an exponential law. The effect of the depth of water was ascertained by laying the cable so that it gradually increased in depth from 10 m. to 100 m. in a length of 60 km. At 500 cycles the field at the surface of the water decreased to the 1/1.42nd part for each 10 m. increase in depth. At 1,000 cycles the corresponding fraction was 1/1.51. This exponential decrease points to the formation of eddy currents in the water. The electric field was examined by immersing two electrodes in the water and connecting them to a search coil electromagnetically coupled to the acoustical receiving apparatus. Only few tests were made, but it was found that the electric field decreased inversely as the square of the distance from the cable.

The Optophone.—Some years ago we described an instrument for enabling the blind to read ordinary print, called the "optophone." At the time the idea was considered good, but rather impracticable for ordinary purposes, and it is with great admiration for the work of Dr. E. E. Fournier d'Albe, Mr. W. Forster Brown, and Messrs. Barr & Stroud, Ltd., of Glasgow, that we read of the success attained by recent developments of the apparatus. The latest form is described in detail in a recent issue of *Nature*, and the writer, Dr. Fournier d'Albe, considers that "the problem of opening the world's literature to the blind is now definitely solved."

A Rat on the Bus-bars.—The presence of rats, and the subsequent damage to switchgear, &c., seems to be a very prevalent form of "fault" nowadays. Yet another report of such an occurrence reaches us from Mr. R. Gossage, chief electrician to Messrs. Alldays & Onions, "Matchless" Works sub-station. On the morning of May 2nd, Mr. Gossage went to the switchboard to switch on the power for some pumping operations; immediately the switch was closed there was an explosion, and an H.T.



A Rat on the Bus-bars.

cubicle burst into flames, scorching Mr. Gossage's arm and hand. The bus-bars and contacts were damaged considerably, and six H.T. insulators were smashed. Upon subsequent investigation, it was discovered that a large rat had got across the bars, as the accompanying photograph shows—with fatal results to itself, of course. It seems as though a rat-trap will soon have to be a recognised item in power-station equipment, as the present method of destroying rats is far too costly.

Fraternity.—By "Ruddigore." A little poem dedicated to the Corporation of York, which recently advertised for a jointer at a wage of £4 7s. 6d. per week, and for a mains superintendent at a wage of 6d. a week more.

When I was young and very fly
I thought the world was all awry;
I studied books on politics
Learnt all its "isms" and its tricks.
In short—I found for perfect rhythm
We all should plump for communism.

So when my father said to me,
"Now, boy, what do you choose to be?"
All his proposals I turned down—
They might bring money, fame, renown.
I answered, "I shun profiteering.
My predilection's engineering."

"For there, no matter what your age,
You always get the same low wage,
And though you rise to be the chief
It never brings you much relief.
The slide-rule calculating joker
Is just the equal of the stoker."

But now I'm nearing fifty-four
My views are not quite those of yore.
My communistic life has seemed
Not quite the heaven that I dreamed.
In fact—I fear I'm growing slacker.
I've thought of selling tripe, or 'bacca.

Corona Discharge.—Under this title a recent issue of *The Iron and Coal Trades Review* gives details of an exhaustive investigation carried out at the University of Illinois.

The authors considered that a study of the corona caused by continuous potentials may produce engineering data of value owing to the increasing development of high-tension direct-current generation and transmission, and for this reason the experiments were conducted with continuous potential.

The type of the corona discharge tube used in most of the experiments was a cylinder with a wire strung along its axis. This type of tube was chosen for several reasons:—(1) The corona phenomena occurring when this type of apparatus is used lend themselves peculiarly well to mathematical analysis. (2) The construction, manipulation, operation, and repair of the apparatus are extremely simple. (3) The field distribution is symmetrical with respect to the wire, and any irregularities in the wire are immediately recognisable in the discharge. (4) This type of apparatus has been used by other investigators; thus results could be compared with greater assurance of reliability.

As the voltage across the corona apparatus is gradually raised, a point is reached when a marked increase in the current occurs, and a further increase in voltage causes the current to increase very rapidly. The voltage at which this sudden increase occurs is called the "critical voltage." "Visible glow voltage" means the voltage at which the light about the wire first appears. The visible glow voltage may be identical with, or higher than, the critical voltage.

The positive and negative coronas have entirely different appearances.

Wire Positive in Air.—For all pressures and sizes of wire used a uniform purple glow surrounds the positive wire. The wire has a tendency to vibrate at high pressures and high current densities, The thickness of the luminous film seems to be a constant for all current densities and pressures, the density or brilliance of the discharge only varying with the current and pressure.

Wire Negative in Air.—With the wire negative the appearance of the corona is changed in a very marked degree. The following properties can be observed:—(1) With a constant wire diameter and decreasing pressure the discharge gradually changes from a fairly uniform luminous mass with ragged boundaries to a beady discharge. (2) For a constant pressure and decreasing wire radii the fairly uniform luminous discharge gradually changes to the beady discharge, so that for small wires (less than 0·17 mm. in diameter) the beady discharge occurs at all pressures between atmospheric and 50 mm. of mercury. Under certain conditions of pressure and voltage these negative beads, or brushes, distribute themselves uniformly along the wire. For the lowest pressures the beads consist of a bright cylindrical core along the wire, this core being surrounded by a narrow dark space and enveloped in turn by a purple glow of relatively large diameter. For increasing pressures the central core contracts to a point on the wire, from which the discharge spreads out fanlike in a plane at right-angles to the wire. For still higher pressures the fan seems to close and finally to degenerate to a small brush.

Moisture.—To determine whether the presence of moisture in the air has an effect upon the critical voltage, a test was run as follows under a pressure of 736 mm. and humidity 68 5 per cent. Air was drawn from the room through the tube, and the voltage was noted at which the initial jump of the galvanometer occurred for the wire positive. The positive glow voltage and the negative glow voltage were then determined. Then dry air was pumped through the tube and the same measurements were taken. The results were:—

	Wet air.	Dry air.
Positive critical voltage	4,300	4,190
Positive glow voltage	4,350	4,260
Negative glow voltage	4,275	4,370

The effect of moisture apparently is to raise slightly the starting point of the positive corona, but the reverse is true for the negative polarity.

Slight differences in the starting points for the different metals were noticed; these differences, however, are of such a nature that they cannot be explained as being experimental errors. Steel and copper seem to have about the same starting point, while that for aluminium is a little higher and silver has a value still greater. The different metals not only affect the behaviour of the characteristic curves but also the starting points of the corona glow.

The voltage used for the experiments varied considerably, but did not much exceed 9,000 volts.

Naval Wireless Telegraphists.—In order to assist ratings of the wireless telegraph branch of the Royal Navy due for discharge in obtaining posts as civilian wireless telegraph operators, the Admiralty has arranged with the Postmaster-General for the issue of the latter's certificate of proficiency to such ratings on their passing an examination in the naval signal schools while still serving. It has not been possible for the Admiralty to make similar arrangements for the examination of telegraphists who have been discharged or demobilised, and such men should apply for the certificate direct to the Secretary of the General Post Office, who will inform them of the conditions of the examination.—*The Times.*

Service Notes.—The Admiralty announces that rules have been approved for determining the dates from which officers specialising in engineering shall become eligible for the higher rates of pay laid down for the engineer branch in July last, as a result of the Halsey Committee's recommendations.

Lower-deck Improvements.—A recent note in *The Times* foreshadows a great improvement in the living conditions of petty officers of some of the Navy's light cruisers. Electric lighting is to be installed in messes and reading-rooms, and electric heaters for keeping meals hot, as well as radiators and other appliances.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The forty-eighth annual general meeting of the Institution was held on the 20th inst.; there was a very small attendance, and few comments were made. The President, Mr. Roger T. Smith, announced the result of the election of members of Council, as follows:—

President, Mr. Ll. B. Atkinson; vice-presidents, Dr. W. H. Eccles, Messrs. J. S. Highfield, and S. L. Pearce, C.B.E

hon. treasurer, Sir J. Devonshire; ordinary members of Council, Messrs. F. Gill, P. V. Hunter, A. H. W. Marshall, W. Noble, C. Vernier, and Dr. A. Russell.

Out of the total of 1,526 ballot papers that were returned, 29 were spoiled, leaving 1,497, or about 32 per cent. of those issued, which was a good improvement on past years.

The President introduced the report of the Council for the year 1919-20, an abstract of which appeared in our last issue, with a running commentary, in the course of which he mentioned that the gratifying increase in membership was to some extent an estimate, as there were a number of members whose subscriptions had lapsed, and they were not yet sure how many of them had definitely ceased to be members. He pointed out that although the number of subscribers to the Benevolent Fund had increased substantially, the amount subscribed had remained practically at the same level as before. Referring to the benefaction to the Institution announced in the report, he said that both the donation and the manner in which it was given, were admirable examples to them all, and trustees had been appointed for the Institution. To the list of territorial centres and sub-centres that had been visited by the President during the session, Loughborough could now be added. Owing to the continued increase in the cost of publication, the Council regretted that it had been compelled to increase the subscription rates for *Science Abstracts*. The premiums awarded by the Council for papers read before the Institution during the period April 10th, 1919, to April 15th, 1920, were then announced, as follows:—The Institution premium, valued at £25, to Mr. M. B. Field for his paper on "The Navigational Magnetic Compass"; Ayrton premium (£10) to Mr. W. H. Patchell for his "Notes on Operating a By-product Producer-Gas Plant for Power and Heating"; Fahie premium (£10) to Messrs. E. A. Laidlaw and W. H. Grinsted for their joint paper on "The Telephone Service of Large Cities, with Special Reference to London"; John Hopkinson premium (£10) to Mr. J. C. Thompson for his paper on "Transformers for Electric Furnaces"; Kelvin premium (£10) to Mr. H. W. Taylor for his paper on "Eddy Currents in Stator Windings"; Paris premium (£10) to Mr. G. Stead for his paper on "The Short Tungsten Filament as a Source of Light and Electrons"; Webber premium (£10) to Major A. C. Fuller for his paper on "The Fullerphone, and its Application to Military and Civil Telegraphy"; an extra premium (£5) to Captain J. M. Scott Maxwell for his paper on "Scientific Management: a Solution to the Capital and Labour Problem"; and another extra premium (£5) to Major K. Edgcumbe for his paper on "The Protection of A.C. Systems without the Use of Special Conductors."

The motion to receive the report was seconded by Mr. J. Shepherd, and, without comment, the report was adopted unanimously.

Sir James Devonshire, in moving the adoption of the accounts for the year ended December 31st, 1919, said that that was his first presentation of the accounts since the resignation of his able predecessor, Mr. Kingsbury. The cost of publication of the *Journal* continued to increase. The temporary housing of the Institution at Albemarle Street was, from a financial point of view, entirely satisfactory, as the Institution thereby benefited to the extent of nearly £4,000. Negotiations had been opened for the sale of the Tothill Street property, and he was glad to announce that there were prospects of disposing of the property on favourable terms. The accounts showed a margin to the good of £1,495, an increase of £225.

Prof. J. T. MacGregor-Morris seconded the motion; few remarks were made, and the accounts were adopted unanimously.

Messrs. Allen, Attfield & Co. were appointed hon. auditors for the year 1920-21, and the proceedings terminated with votes of thanks to the Institution of Civil Engineers for the use of its premises and library, and to the hon. officers of the Institution at home and abroad.

North Midland Centre.—The annual meeting of the Centre was held at Leeds on May 11th. The chairman (Mr. W. M. Selvey) presided. The accounts for the past year were unanimously approved. The ballot for members of the committee for the ensuing year resulted in Messrs. Furness, Jones, Spurr, Turner, Col. Vignole and Mr. Wraith being elected. Mr. Leonard Milne then read his paper on the "Electrical Equipment of Artisan Dwellings," and a discussion followed.

Local Centre in Argentina.—The first Committee is made up of the following members:—

Chairman: Vernon Lindop.

Vice-chairman: W. C. Laidler.

Members: J. T. Cornish, H. L. Randolph, L. B. Trant, and J. Wilson.

Secretary: A. C. Kelly, 783 calle Florida, Buenos Aires.

The Committee will be glad to be of assistance in any matter affecting the interests of the British Electrical Industry and of British Electrical Engineers.—*Review of the River Plate.*

Society of Chemical Industry.—Modern High-speed Electric Telpherage was the subject of a paper at a Conference of the Chemical Engineering Group (National) of the Society of Chemical Industry, at Birmingham, on April 23rd. The author, Mr. H. Blyth (Strachan & Henshaw, Bristol), pointed out that in all branches of industry there was a necessity to-day for doing everything at high speed and with the greatest all-round economy. The electric telpher was a particularly convenient and simple machine for conveying any class of goods or materials over a moderate distance with a minimum consumption of energy and at a low maintenance cost. Telpherage had been very extensively adopted in gas works for handling coke and other materials, and also in electricity works for coal and ashes.

A coal telpher, fed by crane, was installed at Stepney electricity works. It was not permissible in this case to have the telpher structure overhanging the barge, and a three-motion crane had to be used to transfer the coal from the barge, first to the hopper of the automatic weighing machine, which in turn discharged the coal to the bunker which fed the telpher skip. The supply of coal was kept up in the bunker, and the telpher operator lowered his skip in front of the automatic shoot; the skip was filled in about 10 seconds (two tons of coal), lifted 40 ft., and carried a maximum distance of about 300 ft. The capacity (guaranteed) of the plant was 40 tons per hour, but in an emergency 70 tons per hour had been handled.

In 1916 Messrs. Nobels required to unload coal from 10-ton wagons and store it evenly over an area of 350 ft. × 136 ft. × 10 ft. deep, and it was necessary to provide for a storage of 12,000 tons. The coal trucks are emptied by a Fraser & Chalmers tipper, at the rate of eight to ten per hour, into a pit which has a partition at a depth of 15 ft. and a chamber 7 ft. deep below this partition. Coal can be lifted by the telpher and grab from the upper portion of the pit at the rate of 40 to 50 tons per hour, and conveyed to store, and simultaneously conducted at about the same rate by means of a rotary feed table, below the partitions, to an elevator, and thence by a band conveyor to the boiler-house bunkers. The special feature of the telpher installation lies in the fact that the track itself is made to travel the full length of the store ground, and by means of a running switch maintains contact with the fixed track leading to the grabbing pit. The telpher machine can thus lift the coal from the pit and convey it directly to any part of the store ground, and similarly pick up from any point of the store and carry it back to the pit for feeding the elevator and conveyor for the boiler house. It was not possible in this case to run the track through to the boiler house, as the structure for the latter had already been determined when the telpher was ordered for the store.

The telpher has a lifting motor of 20 H.P. and a travel motor of 8 H.P., the energy consumption per hour being 6 units—that is, 0·15 unit per ton. The present-day labour cost would be ½d. to ¾d. per ton. The elevator is driven by a 10-H.P. motor, and the band conveyor, 5 H.P.; total consumption, 11 units per hour.

Societe des Ingenieurs Civils de France.—This institution is organising a tour in France, from June 22nd to 25th, primarily for its British section, but it has been decided to admit members of any recognised British engineering institution. The tour, which embraces Paris and the factories and mines of the north-eastern war area, including Amiens, Lens, Lille and Vimy, will cost about £12, and a programme has been arranged and can be obtained from the Hon. Secretary of the British Section, 45, Great Marlborough Street, W. 1.

Institute of Transport.—Reading a paper on "Some Railway Operating Problems," on May 17th, Major-General Sir H. W. Thornton, general manager and engineer-in-chief of the G.E. Railway, said he hoped to increase the already heavy train service during the rush periods by 40 per cent. The trend of thought was towards private ownership and administration under Government regulations. To deal with the London traffic problem, in addition to other improvements, they must employ electricity in the suburban zone on a very large scale.

British Science Guild.—At the annual meeting of the Guild, to be held at the Goldsmiths' Hall, Foster Lane, E.C., on Tuesday, June 8th, at 3 p.m., Lord Sydenham, G.C.S.I., F.R.S., in vacating a Presidency marked by two most successful Scientific Products Exhibitions, will deliver an address on "Science and the Nation," and this will be followed by an address on "Some National Aspects of Transport," by the incoming President, Lord Montagu of Beaulieu. Lord Bledisloe and Sir Gilbert Parker will indicate what has been done in the past year in this connection, and describe the significant efforts now contemplated by the Guild. Applications for invitations to the meeting should be addressed to the Secretary of the British Science Guild, 6, John Street, Adelphi, W.C. 2.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. Weston has resigned from the Sterling Telephone and Electric Co., Ltd., and has joined Crysalco, Ltd., as London representative, with office at Craven House, Kingsway.

Mr. E. G. Phillips, M.I.E.E., who for the last 12 years has been chief engineer to Messrs. Boots Chemists, Nottingham, has resigned that position and opened offices at Queen's Chambers, King Street, Nottingham, as a consulting engineer, specialising in power plants working against back pressures, and utilising the exhaust for "process" work. On Friday last at the Island Street works, over 100 of the power house staff and engineering department presented Mr. Phillips with a secretarial desk. Mr. T. S. Ratcliffe, general manager, made the presentation, and Mr. H. B. Clarke, chief technical assistant, expressed the staff's esteem and appreciation.

Recent changes in the civilian staff at the Admiralty outports, include the following:—Electrical Engineering Department—Mr. H. Martin, to Electrical Engineer, Lower Grade, Portsmouth

Yard (Acting); Mr. W. A. Knight, to 1st Assistant Electrical Engineer, Portsmouth Yard; Mr. G. R. Davies, to 1st Assistant Electrical Engineer, Dover Yard (Acting).

Mr. J. W. A. Renshaw, assistant electrical engineer of Fleetwood, has been granted an additional bonus of £30 per annum.

On May 21st, Mr. F. C. Edgars, foreman armature winder to the Halifax Tramways Committee, was presented with a silver flower vase by the members of the staff. He is about to start business in the electrical trade on his own account. He had been with the Corporation over 20 years.

Lieut. H. Foster Smith, R.E., M.C, has been appointed chief engineer to the Electric Lighting and Tramways Co, Para, North Brazil.

Lieut. Breeds, of Morecambe, has been appointed traffic manager to the Morecambe Corporation.

A Reuter dispatch states that Sir Auckland Geddes, on May 19th, received the Franklin Medal from the Franklin Institute for Sir Charles Parsons.

Messrs. Charles P. Sparks & Partners have changed their address to Blackfriars House, New Bridge Street, London, E.C. 4. Telephone Nos. "4725 and 4726 Central."

Mr. T. MacLennan, first engineer at Lake Coleridge hydro-electric station, New Zealand, has been appointed public works electrical engineer at Hamilton (N.Z.), and will take charge of the Hora Hora works. Mr. H. S. Dix, engineer and manager of the Prahran and Malvern tramways trust, has been appointed acting chief manager and acting chief engineer of the Melbourne Tramways Board, which controls the cable and electric tramway services of the metropolitan and suburban areas.—*Commonwealth Engineer.*

Obituary.—Mr. R. Sharp.—The death has taken place of Mr. Robert Sharp, of Briercliffe Road, Burnley, who had been for many years in business as an electrician. He was in his 59th year.

CITY NOTES.

London and Suburban Traction Co., Ltd.

Lord Ashfield presided at the annual meeting on May 19th. He said that the result was disappointing, but no other result could have been expected considering the expenses and how little the fares, &c., had been advanced. Increased operating expenses more than counterbalanced the increase in revenue of the three companies. There were no signs of any decrease in the price of materials necessary for the operation and upkeep of the undertakings, and further demands were received for increases in the wages of the operating staff. It was therefore essential that more revenue should be earned. The Government had introduced the Tramways (Temporary Increase of Charges) Bill, which, while it did not afford a permanent measure of relief, would give the companies an opportunity of increasing their revenue by bringing the fares more into relation with the present economic position and with the expenses of carrying the traffic. It remained to be seen to what extent the public would accept this additional burden, but he could not but believe that they would be willing to pay such fares as might be necessary to meet reasonable working expenses and to provide adequate sums for depreciation and a fair return on capital. There was a rate of fare which would secure the maximum earnings, and to go beyond that rate of fare would reduce the earnings and bring disaster to the undertakings. He would, therefore, take that opportunity of warning those who were constantly agitating for increased wages that they could overburden the undertakings and bring disaster to themselves and to all those associated with them. The tramway and omnibus undertakings in which their company was interested were not earning sufficient to meet their actual expenses, and until fares had been increased and it was known definitely just how much the public would pay, and whether sufficient revenue could be obtained to meet even the present expenses, including depreciation and a reasonable return on capital, it was difficult to see how further increases in expenses could be incurred.

Calcutta Electric Supply Corporation, Ltd.

The report for 1919 shows as follows: Units sold 31,881,710, as against 30,431,132 in 1918. Houses connected 10,271, an increase of 374. Gross revenue £359,949, against £304,955. Net revenue £237,206, against £173,949. The net profit for 1919, plus balance brought forward and interest received, totalled £298,459. £34,408 has been placed to the credit of the depreciation and renewals account. The balance of excess profits duty in respect of 1917-18 £27,724, and an estimated liability in respect of 1919 for similar duty £34,070, is provided for. £55,000 is put to reserve, £5,000 to the insurance fund, £5,000 to the pension fund, and a final dividend is recommended on the ordinary shares for the second half-year of 6 per cent. actual, making 10 per cent. for the year. Further, it is recommended that, subject to the shareholders' approval and to the alteration of the articles of association, one fully-paid preference share shall be issued as bonus for each 10 ordinary shares held, fractions to be paid in cash. A balance estimated at £45,693 is carried forward after providing for the directors' additional remuneration of £4,000. Expenditure on capital account last year £51,653. Total outlay to December 31st last £1,438,009. The demand for electrical energy still continues to increase. In order to meet the same, after considering a report on the situation from their consulting engineers in conjunction with the company's engineer, that the capital should be increased, the directors find themselves inevitably committed to an increase of the system involving 1½ millions sterling. The power station must be more than doubled, and the network of distribution in proportion; they therefore recommend that the capital shall be increased from £1,500,000 to £3,000,000 by the issue of 300,000 additional shares of £5 each, also that the rate of dividend payable in respect of the preference shares be increased from 5 to 6½ per cent.

Swedish Companies.

The Elektriska Aktiebolag Volta reports that a total loss of 1,129,000 kr. was incurred in 1919, of which 656,000 kr. concerned the manufacturing departments, as compared with net profits of 555,000 kr. in the previous year on a share capital of 5,000,000 kr. All the subsidiary companies are being liquidated, and the Volta company itself is to be reorganised by the formation of a new company with a share capital of 6,500,000 kr.

The directors of the *Telefon A.B. Cedergren, of Stockholm*, reporting on the past year, states that the network in Warsaw was for the most part restored after the damages caused during the German occupation. The company's concession expired on November 14th, 1919, and a provisional agreement was entered into with the Polish Ministry to continue working until July 1st, 1920, whilst negotiations were proceeding as to the conditions for further maintaining the service. The total loss for the year amounts to 1,889,000 kr., of which 883,000 kr. represents the writing down of Russian debts.

The report of the *A.B. Elektraverken* states that the situation of the market in 1919 was not satisfactory for the company's manufactures. The unfavourable conditions of exchange facilitated foreign competition, and compelled the company for the present to cease the production of batteries and thermo flasks, and rendered impossible the export of other manufactures. The results were also prejudicially affected by a three months' strike at the installation materials factory, and the great advance in wages. As net profits the accounts show the sum of 557,000 kr., as against 713,000 kr. in 1918, when a dividend at the rate of 10 per cent. was paid. It is, however, not proposed to make any distribution for last year, but to dispose of the surplus available by allocations to the renewal and reserve funds, and by the carrying forward of 318,000 kr., as compared with 157,000 kr. in 1918.

French Companies.

The Compagnie de Telegraphie Sans Fil reports net profits of 2,525,000 fr. for 1919 and a dividend of 40 fr. per share, this comparing with 27.22 fr. per share for the eleven months comprising the previous financial year.

The Société d'Electro-Chemie de Bozel has declared a dividend at the rate of 22 fr. per share out of net profits of 762,000 fr. in 1919, as against 22 fr. and 766,000 fr. respectively in the previous year.

The net profits of the *Société Gramme* in 1919 are reported at 697,000 fr., as compared with 703,000 fr. in the previous year. After making allocations to the legal reserve fund and provision for the tax on war profits, there remains a balance of 402,000 fr., permitting of the payment of a dividend of 50 fr., as against 48 fr. per old share and 25 fr. per new share in 1918.

The Société d'Electro-Chimie et d'Electro-Métallurgie, which last year absorbed the Electro-Chimique du Giffre et des Carbures Métallurgiques and increased the share capital from 18 to 35 millions of francs, reports net profits of 3,855,000 fr. for 1919 as compared with 1,546,000 fr. in 1918. It has been decided to pay a dividend of 45 fr. per share on the augmented capital, this contrasting with 50 fr. per share in the previous year.

Babcock & Wilcox, Ltd.

The net profit for 1919 was £455,089, plus £92,089 brought forward. After paying the interim dividends of 3 per cent. and 2½ per cent. on the preference shares, and 6 per cent. on the ordinary, further dividends at the same rates on the preference and 9 per cent., free of income tax, on the ordinary shares, are to be paid; £150,000 is to be put to reserve; £10,000 is to be put to staff pension fund; and £123,225 carried forward. The capital has been increased by 500,000 ordinary shares, but these do not rank for the dividend now announced on the old ordinary shares. The construction of the works of the Sociedad Espanola de Construcciones Babcock & Wilcox will be completed this year. The company is equipping auxiliary works in Australia and Italy, and is extending its Japanese works. The French B. & W. works, in which the company is interested, have been enlarged and the capital of that company increased. At Renfrew considerable extensions are being undertaken; a new foundry and pipe shop are being built, the crane making department is being enlarged, and new offices are being erected. Extensions are in progress at the Dumbarton works. The use of B. & W. marine boilers is increasing, and the amount of orders in hand for all the company's manufactures is satisfactory. "Whilst there is some improvement noticeable in the output of our workmen, it is still below the pre-war standard, and there are also continual interruptions, through trade disputes, to contend with."

Belgian Companies.

The accounts of the *Ateliers de Constructions Electriques de Charleroi* show total profits of 2,703,000 fr. for 1919. It is therefore possible to extinguish the provisional debit balance of 2,337,000 fr. which existed at the end of 1918, pay interest on the loans, and carry 209,000 fr. forward.

The Compagnie des Railways et de l'Electricité reports net profits of 359,000 fr. for 1919, which sum has been carried forward. At the recent general meeting the chairman stated that the company hoped to resume the payment of dividends next year, and the directors were devoting special attention to industrial undertakings which were more remunerative than tramways and supply works.

The Société Générale Belge d'Entreprises Electriques reports net profits of 784,000 fr. for 1919, and a dividend at the rate of 25 fr. per share has been declared on the old capital and 1.67 fr. per share on the partly-paid shares. The report states that the supply works in which the company is interested have profited in general by the resumption of industrial activity, especially as the use of electricity is becoming general, and electric motors are being increasingly adopted both by small and big industries. At the same time, the public authorities in most cases have sanctioned an advance in supply tariffs and in tramway fares.

German Companies.

The directors of *Voigt & Haeffner A.G., of Frankfort-on-Main*, recommend a dividend at the rate of 18 per cent. for 1919, being the same as in the previous year.

The accounts of the *Elektro-Salpeterwerks A.G., of Berlin*, show net profits for 1919 which permits of the reduction of the debit balance from 1,420,000 marks to 1,380,000 marks.

The *Norddeutsche Seekabel Werke A.G., of Nordenham*, after making provision for depreciation and losses on investments, reports a loss of 47,000 marks for 1919, as compared with net profits of 291,000 marks in 1918.

The *Ver. Isolatoren Werke A.G., of Berlin-Pankow*, after making provision for depreciation, reports net profits of 166,000 marks for 1919, as compared with 126,000 marks in the preceding year. The directors recommend a dividend at the rate of 12 per cent., this comparing with 10 per cent. in 1918.

The accounts of the *Elektrochemische Werke, of Berlin*, after writing off 2,100,000 marks for special depreciation on new plant in 1919, as against 900,000 marks in 1918, show net profits of 2,629,000 marks, as compared with 1,926,000 marks in the previous year. It is intended to distribute a rate of 15 per cent., this comparing with 12 per cent. in 1918.

The accounts of the *Bergmann Elektrizitats Werke A.G., of Berlin*, show gross profits of 22,162,000 marks for 1919, as compared with 23,683,000 marks in the preceding year. After providing 1,937,000 for depreciation, as against 2,578,000 marks, the net profits are returned at 7,448,000 marks, as compared with 7,149,000 marks in 1918. It is proposed to pay a dividend of 12 per cent. on the paid capital of 47,750,000 marks as in the previous year. The unpaid capital is to be called up, and the share capital then increased by 28,000,000 marks to 80,000,000 marks.

Neuhausen Aluminium Industry Co.

The report for 1919 of the Aluminium Industrie A.G., of Neuhausen, states that the expectations that with the conclusion of peace the conditions of production and sale would revert to normal paths, and relief take place in the provision of raw materials, had not been fulfilled. On the contrary, increased difficulties had to be contended with in order to supply the works with raw materials. With the exception of the Lend works in German Austria it was possible to maintain restricted working at all the manufacturing plants, and the production under these circumstances was less than in the preceding year. In addition to the large decline in the output, the unfavourable conditions of exchange, the enormously increased wages, and the advance in the cost of raw materials and freights, were the causes of the less favourable results as contrasted with the preceding year. The gross profits, including the balance forward declined from 38,062,000 fr. in 1918 to 16,390,000 fr. last year. After considerably reducing the amount provided for depreciation as compared with 1918, the net profits have fallen from 12,093,000 fr. in the latter year to 8,821,000 fr. in 1919. As recently mentioned, the dividend is at the rate of 18 per cent. on ordinary share capital of 42,000,000 fr., this comparing with 20 per cent. in 1918 and 20 per cent. in each of the three preceding years on considerably less capital. The report further states that the seizure of the works in France had not yet been raised, although speedy settlement was to be foreseen. The Hungarian Bauxite Co. had to suspend activity after the revolution, and had not yet been able to resume. Nevertheless the Neuhausen Co. possessed large stocks of bauxite which would last a long time forward.

Edison Swan Electric Co., Ltd.—The financial Press states that the directors propose to increase the borrowing powers of the company.

Brisbane Electric Tramways Investment Co., Ltd.—Dividend of 8 per cent. per annum, free of tax, on ordinary shares for half-year, making 8 per cent. for the year; £20,000 to reserve; £38,876 carried forward.

Potteries Electric Traction Co., Ltd.—Mr. R. J. Howley, presiding at the annual meeting, said that the traffic receipts amounted to £251,745, an increase of £46,221, due to a small increase in traffic and a further increase in fares. The administration and general expenses increased by £5,022. The introduction of the 48-hour week in April, 1919, had caused the largest single increase in wages which they had had to meet in any year, being equivalent to 13s. per man per week on the old basis of a 60-hour week. In November a further 4s. a week had been granted by an award of the Committee on Production. A further increase of 8s. per man per week, which would rise to 9s. on June 1st next, recently recommended by the National Industrial Council, was now being paid. Increases in wages during the year had out-distanced the increased cost of living, and there must be some finality to the increases which could be granted. Wages continued to advance, and the raising of additional revenue became more difficult. Their efforts had not been unsuccessful during the year under review in maintaining the balance available for distribution, but there was a limit to which fares could be raised.

Richardsons, Westgarth & Co., Ltd.—The profit for the year ended December 31st, after providing for estimated liabilities to the Government, amounts to £185,040, against £133,275 in 1918, to which is added £23,818 brought forward. One year's arrears of preference dividend to April 30th, 1912, paid June 17th, absorbed £21,000; two years' arrears of preference dividend to April 30th, 1914, paid November 28th, £42,000. It is proposed to allocate £45,000 to depreciation for 1919; portion of capital expenditure in 1919, written off, £13,565; leaving a credit balance of £48,842. The company's liability for excess profits duty for the past four years has not yet been finally adjusted, but it is estimated, says the *Times*, that out of the retainable profits for the year 1919 a total payment of £105,000 can be made to the preference shareholders. Of this sum, a distribution of £63,000, as shown above, has already been made, and it is now proposed to pay £42,000 out of the balance of profit remaining; the dividend on the preference shares will then have been paid to April 30th, 1916.

Arbroath Electric Light and Power Co., Ltd.—Mr. George Balfour, M.P., said at the annual meeting that the present consumption of current was about 30 per cent. greater than that of a year ago. Naturally this increase of business, he said, required an extension of their plant and machinery and cables, and each, of course, meant additional capital. After referring to the arrangements for the increase of capital, he said it was not the intention to issue all the new shares at one time, but the directors had thought it wise to make ample provision, and shares would be issued as and when fresh capital was required. A special vote of thanks was passed to the engineer (Mr. J. Cathcart Christie) and his staff.

Anglo-American Telegraph Co., Ltd.—The three quarterly interim dividends on the preferred and ordinary stock absorbed £157,500, and the directors on January 31st last paid the final dividend of 30s. per cent. for the year on these shares and on the deferred stock. These payments absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3½ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. The balance at credit of revenue account (£68,822) includes £3,197 interest received, and the balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1920.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Erinoid, Ltd.—100,000 shares of 5s. each fully paid (Nos. 600,001 to 700,000).

Greenwood & Batley, Ltd.—168,000 ordinary shares of £1 each, fully paid (Nos. 1 to 168,000); and 96,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 96,000).

The Committee has sepcially allowed dealing in the following under temporary regulation 4 (3):—

River Plate Electricity Co., Ltd.—122,440 ordinary shares of £1 each, fully paid (Nos. 175,001 to 297,440).

Ramsgate & District Electric Supply Co., Ltd.—Profit for 1919 £4,247, as against £2,026 for 1918. After deducting interest on outstanding accounts due to contractors (£1,139) and adding £743 brought forward, the balance is £3,857. Dividend 5 per cent.; £2,000 to reserve; £857 carried forward. Mr. A. N. Rye has been elected a director in place of Mr. A. D. Chamen, resigned.

Mirrlees Bickerton & Day, Ltd.—The report for the year ended March, 1920, states that the net profit, after providing for depreciation and excess profits duty, &c., is £41,842, plus £5,720 brought forward. It is proposed to pay a dividend on the ordinary shares, making 12½ per cent., free of tax, placing £5,000 to reserve, and carrying forward £7,510.

British Mannesmann Tube Co., Ltd.—Interim dividend of 4 per cent., less tax.

Dublin and Lucan Electric Railway Co.—At the annual meeting Mr. J. W. Hill said that the gross income had largely exceeded that of any previous year. The increase was accounted for to a certain extent by the increased passenger fares, but the increase in the number of passengers as against those carried in the previous year was almost 52,000. The service was still curtailed, but it was hoped to improve it. As to expenditure, wages were double the amount of 1918 and coal was dearer, while the coal supply prospects were anything but reassuring.

Companies Struck off the Register.—The following have been struck off the register and are dissolved:—

Faringdon Electric Light and Power Co., Ltd.
Star Vacuum Cleaner Co., Ltd.

Western Telegraph Co., Ltd.—Interim dividend of 5s. per share, free of tax.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets appear to be the better for their Whitsun holiday, and a fair amount of business rewarded those who were sufficiently conscientious to return to town to-day (Tuesday). The holiday passed without giving rise to any unexpected complications at home and abroad, so there was nothing to check the mildly better tone established at the end of last week.

The dramatic drop in many prices in the commodity, food and metal markets is regarded from various points of view. New York sends apprehensions as to its further course being undesirable in view of possible slump consequences in the market for Government and other securities, and this aspect naturally occurs to the holder of stocks and shares, the prices of which are bound to suffer if forced liquidation goes to extremes. At the same time, it is well recognised that the fall in Stock Exchange prices has been extremely severe during the past two months, and that the forced selling has been accomplished to no small extent already. The City, therefore, is not alarmed at the outlook, and the manner in which gilt-edged stocks are supported is evidence of the investors' frame of mind.

People are buying preference shares and fixed interest stocks to-day on the ground that dividends on ordinary shares are likely to be eaten into by the additional E.P.D., and that this may make material difference to the dividends on ordinary shares. In these circumstances, the attractions stand out from such investments as General Electric 7½ per cent. B preference, which can be bought at about 19s. 3d., and are representative of the class of shares for which the investor is now asking. No doubt the course of time will bring the ordinary shares into favour again, but—equally no doubt—preference issues are more popular with the public at present.

Electricity Supply shares are weaker on account of several decreased accounts which have come to market this week. County ordinary and preference have felt this more particularly, but London Electrics and Metropolitans also gave way. City Lights are quoted in their £1 (instead of £10) guise, the ordinary being called 1½ and the preference 17s. At these prices the former give a return of nearly 9 per cent. on the money, and the preference offer a little over 7 per cent. Calcutta Electric Supply are 5s. lower at 8, although the report is regarded as being quite a good one.

Edisons at 23s. 9d. have hardened up; otherwise the manufacturing group is dullish, with General Electrics easier at 31s. 3d., and Siemens at 26s. Henleys shed 1-16 to 40s. Castner Kellners recovered to 4 on the declaration of an interim dividend at the rate of 20 per cent.

The International, which took over a large part of the Automatic Telephone shares, issues a report dealing with the share capital and other figures, but which is otherwise colourless. American and other dollar securities are lower in many cases, the New York Stock Exchange being subject to depressing conditions due to causes not unlike those which have made prices dull over here. Cuban Telephone 6 per cent. preference fell 2 to 120, and American Telephone and Telegraph capital stock dropped to 117½. Rio Tramways 1st mortgage bonds weakened to 82½. Brazilian Tractions reacted to 49½, after being above 50. The Anglo-Argentine Tramways list is rather firmer, the first preference hardening to 3½. Mexican Light and Power firsts at 41 are 5 points better on the fortnight. The death of President Carranza has had little effect other than this upon Mexican issues. Stock Exchange opinion, already quoted, persists that no change can be for the worse in Mexico.

Cable stocks are as langourous as the weather. Anglo-American deferred continues its downward course. Globe ordinary shares are 5s. lower. West India and Panama have given away further to 10s. owing to the poor report. Shares changed hands down to 8s. 6d. Marconis remain a firm market at 3½, but the new ordinary are still at 2s. 6d. discount, and Marines are 1-16 better at 38s. 9d.

Reference was made here last week to Atkin's "Manual." To quote further from its pages may appear to savour of laziness on the part of the commentator, yet, in these kaleidoscopic days, it is very interesting to have a lucid reminder of the Electricity Bill (1919) which is now law. Risking the charge just mentioned, we repeat from the Manual before us: "This Bill, owing to strong opposition in the House of Lords, directed specially against its financial proposals, was considerably modified . . . all its compulsory features withdrawn, and the proposals relating to the appointment of Commissioners and the control and advice which they are enabled by the Act to give in connection with the development of electricity were retained." The power enjoyed by the London County Council to purchase in 1931 the undertakings of all the companies together for fair market value without goodwill (Electric Lighting Act, 1888) is now transferred to the Joint Electricity Authorities for the area in which a company operates. This is how the position stands at present, and the element of uncertainty which obviously continues to exist is sometimes held responsible for the reluctance that many investors entertain in regard to putting money into electric lighting shares.

Home Railway stocks are more or less moribund. The vast numbers of passengers carried by the motor-'buses during the Whitsun holiday has failed to infuse any interest into the market for the Underground Railways group. Armament shares make a fairly good showing, with Vickers hardening slightly. Rubber shares rallied on the raw material picking up to a florin per lb., which brought in a few buyers and a great many inquiries.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price May 25, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6¾	—	£9 5 9
Charing Cross Ordinary	4	7	8½	—	9 6 8
do. do. do 4½ Pref.	4½	4½	9½	—	8 8 8
Chelsea	3	4	5	—	6 3 4
City of London	8	10	11¼	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—1/-	7 1 2
County of London	7	8	8½	— ½	9 11 2
do do. 6 per cent. Pref.	6	6	8½	— ½	7 3 4
Kensington Ordinary	6	7	4½	—	7 11 6
London Electric	Nil	2½	1½	— ¼	6 0 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	2½	— ¼	10 8 8
do. 4½ per cent. Pref.	4½	4½	9½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	3½	—	9 13 6
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½	—	7 14 10
do. Def.	22/6	1¼	15½	— ½	8 2 2
Chile Telephone	5	6	6½	—	*4 13 3
Cuba Sub. Ord.	7	7	9¼	—	*7 7 4
Eastern Extension	8	10	15	—	*6 13 4
Eastern Tel. Ord.	8	10	13½	—	*6 11 4
Globe Tel. and T. Ord.	8	10	10½	— ½	*6 7 6
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	—	21½	—	9 15 6
Indo-European	13	10	40	—	6 5 0
Marconi	25	—	5½	—	8 0 0
Oriental Telephone Ord.	10	12	2½	— ½	*4 16 0
United R. Plate Tel.	5	—	7½	— ½	*5 6 8
West India and Panama	1/8	—	3	— ½	—
Western Telegraph	5	10	16½	—	*6 7 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	20	+½	5 0 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	4/-	—6d.	Nil
do. do. Income	5	4	60½	—	6 13 8
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8½	+ ½	—
do. do. 2nd Pref.	—	—	5	—	—
do. do. 5 Deb.	5	5	57½	—	8 13 10
Brazil Tractions	—	—	49½	—	—
Bombay Electric Pref.	5	5	13½	—	4 11 8
British Columbia Elec. Ry. Pfds.	5	5	55½	—	9 3 0
do. do. Preferrred	2½	5	48½	—	10 6 2
do. do. Deferred	Nil	8	44½	—	6 14 10
do. do. Deb.	4½	4½	59	—	8 2 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	19½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	41	+2	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	9½	—	*5 4 4
British Aluminium Ord.	10	10	17½	—	9 8 2
British Insulated Ord.	12½	15	14½	—	7 14 8
Callenders	25	—	8	—	7 16 3
" 6½ Pref.	6½	6½	42	—	6 16 10
Castner-Kellner	20	—	4	+ ½	5 0 0
Crompton Ord.	10	—	21/6	—	9 6 0
Edison-Swan, "A"	10	—	1½	+ ⅛	8 8 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6½	6½	18/-	+6d.	7 4 5
do. Ord.	10	—	1⅝	— ⅛	*5 6 0
Henley	25	15	2	— ⅛	7 10 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	13½	—	*7 11 0
Met.-Vickers Pref.	—	8	2⅛	—	6 18 6
Siemens Ord.	10	10	26/-	—6d.	*7 13 10
Telegraph Con.	20	20	23½	—	*5 6 8

† Dividends paid free of Income Tax.

THE LOWER SEVERN ELECTRICITY DISTRICT.

By H. M. S.

(*Concluded from page* 647.)

If the Commissioners sought for an area in which the industrial and population factors vary widely with a large proportion electrically undeveloped, so that their first scheme may be tested through a considerable range of conditions, this area seems to offer a good opportunity. It may be only a coincidence that Hereford, which is in the district, has the only supply undertaking which has definitely tried to cater for agricultural demands. There are those who think that electric supply in rural districts will prove of social and economic value, providing some encouragement to the development of village and home industries, some social amenities, as well as assistance to the agriculturist, and thereby promote an increase in the rural populations which social reformers agree to be desirable.

This district gives the Commissioners an opportunity of testing the theory, if they or others can finance the enterprise.

Another feature of the district is that outside Bristol and Bath the existing supply stations are on the small side, situated in small towns, each isolated from its colleagues by relatively considerable distances, so that interlinking is hardly practicable or of advantage. Also, no part of the area, excepting the Severn shore, appears to offer any facilities for the operation of a large economical station, whilst all parts of it can be reached by transmission lines not exceeding about 50 miles in length, a length which is very moderate compared with American and Continental practice. The conditions, therefore, give a super-station a rather better opening to show its utility, than will be the case in some other areas. It may prove that some of the small isolated stations will find a bulk supply cheaper than their own generating costs, especially as regards any increase in load.

Clearly, if this idea is in the Commissioners' minds, its success depends very much upon the way in which the possibility of supply stimulates the growth of demand throughout the district. As so much of it, including many large villages and small towns, is without a supply now, it is safe to suppose that there is already some unsatisfied demand to start with.

Authorised undertakers within the proposed district will naturally wish to know how the proposals of the Commissioners will affect them, and may bring forward a scheme which will propose the formation of a joint electricity authority with the proposers as the undertaker members. It would not be surprising to hear that such a scheme has already been put before the Commissioners in some form, though this is only guesswork.

But two things may be kept in mind. The first is that if a joint electricity authority is set up, that authority becomes an authorised undertaker for the whole of the district not covered by the areas of supply of existing undertakers, and is under the general obligation of an authorised undertaker to give supplies in the area. This obligation is not unlimited, but may be made mandatory by the Commissioners in respect of any area. It is, therefore, distinctly onerous.

The other is that the Commissioners may not accept any scheme submitted to them, but may amend it or formulate one of their own, and give effect to the amended or substituted scheme. These facts may have a considerable bearing upon the future of existing undertakings. The authorised undertakings in the district are somewhat scattered. Some of them are quite isolated, surrounded by rural territory outside their areas of supply, which does not tempt them to obtain extended powers. The extended power to use overhead lines, and the power of the Commissioners to make orders having the effect of provisional orders, may modify the conditions. What steps can they take to safeguard their interests? Circumstances differ so much in different cases that it would be foolish to offer any general advice. The owners of each undertaking should consider whether the organisation of the supply throughout the district is likely to benefit them, or whether they have anything to fear from it, and shape their course accordingly. The 1919 Act is not very difficult to understand, and a careful perusal of it will reveal the powers, duties, and responsibilities of the authority with reference to individual undertakings.

As before stated, it is known that some of the most important undertakings have conferred, with a view to co-operation in establishing a joint authority, and it may be expected that such a scheme will be put forward with Bristol in the forefront. Any authorised undertakers may, jointly or separately, propose schemes. Whilst other bodies than authorised undertakers may submit schemes, it does not seem likely that any such will propose schemes for this particular district.

The point is that no undertaker can be sure of being left outside the operations of a joint authority by merely refraining from acting with others in preparing a scheme. If such an authority is set up, every undertaking in the district will become subject to its supervision, and at the same time have a right to such benefits as the authority may be able to dispense.

There is, however, nothing to prevent any authorised undertaker from submitting a scheme for the improvement of the supply in its own vicinity.

If all the authorised undertakers in the district can agree upon a scheme in which their separate interests will be equitably treated, and the supply organisation demonstrably improved, the Commissioners will have to give such an agreed scheme very serious consideration. Naturally, in such an event, they will examine it rather closely from the public point of view, but the fact of unanimity will be a strong point. If discussion between the undertakers leaves some of them dissatisfied with the arrangement favoured by the majority, the dissentients will at least have the advantage of knowing what case they will have to meet at the local inquiry, and be prepared to set out their own objections and proposals for amendment.

Some of the undertakers, especially those who are most isolated, may fail to see any advantages to themselves from the operations of a Joint Authority. It appears to be open to them to submit schemes for local improvements, including the extensions of their own areas of supply. The powers given by the Act for the use of overhead lines and the compulsory acquisition of wayleaves may in some cases make this course quite attractive. But the Commissioners cannot grant them an extension of tenure, the one thing needful for small companies.

Another course open to any undertaker is to ask that the proposed area of the district may be altered by excluding the undertaker's area of supply. This can be done by submitting an objection or representation to the delimitation notice under Section 5, Sub-section (1), or the point can be raised at the local inquiry to be held under Sub-sec. (2). The prudent course is to submit an objection. The success of such an objection seems to be the only way in which an undertaking preferring to be left alone can attain that object. But success does not seem very likely, unless it can be shown that the isolation desired will enable the said undertaking to serve the public better than when working under a joint authority. The Commissioners may be expected to examine such a proposition very critically.

It must be remembered that the Commissioners may approve one of the schemes submitted with or without modification, or if no scheme submitted is approved, the Commissioners may themselves formulate such a scheme. Also that the scheme approved does not necessarily include the formation of a joint authority. But as the Commissioners have formally stated that it appears to them that the existing organisation for the supply should be

improved, it is extremely unlikely that things will be left in *statu quo*. That would be an admission by the Commissioners that what they have said should be done, cannot be done.

Under the Act of 1919 no generating station or other property of an authorised undertaker can be acquired by a joint electricity authority without the consent of the owner. But the amending Bill of this Session proposes to empower the Commissioners to establish either a joint electricity authority or a District Electricity Board in any district. A District Electricity Board will take over all the generating stations in the district by compulsory purchase on the terms which were so strongly opposed in the discussions on the 1919 Bill. The opposition last session, and the pressure of time, led to the Government withdrawing these provisions. The 1920 Bill seeks to restore them, with the very important addition that the compulsory purchase powers may (but not shall) be conferred on joint electricity authorities, as well as district electricity boards.

Whether the Commissioners will be in possession of these additional powers when they come to approve or formulate a scheme for the Lower Severn district, cannot yet be said. The Bill has not yet passed its second reading in the House of Commons, a good deal of opposition has been organised, largely on the Government side of the House, and the Irish Bill will block the way for some weeks.

But as the local inquiry will take place after July 31st—one would say in September at the earliest—the fate of the Bill will be decided before the Commissioners have to approve or formulate a scheme. It is not uncharitable to suppose that this fact had something to do with the fixing of the date. It is, however, rather embarrassing for the undertakers who do not know whether the Commissioners will, or will not, have the power to make a scheme with compulsory purchasing powers. It may conceivably make all the difference to their attitude towards any scheme which may be discussed among themselves.

There is this to be said about it. If the authorised undertakers, or a substantial majority of them, can agree upon a scheme which is calculated to meet the public requirements without the introduction of compulsory purchase powers, there seems no particular reason why the Commissioners should put in those powers, supposing that the present Bill has been passed. And if any undertaker considers that it would be to his advantage to transfer a part, or the whole, of his undertaking to the Joint Authority, the scheme may include provision for such transfer on agreed terms.

The weak point of the 1919 Act is that there is no provision for financing Joint Electricity Authorities. Whilst the Act contemplates that these bodies may purchase land, generating stations, and whole undertakings, and prescribes that the consent of the Electricity Commissioners shall be obtained to any proposed capital expenditure, there is not a word showing how the authorities are to raise the necessary capital. It is true that the scheme setting up an authority "may contain any consequential, incidental, and supplemental provisions which appear to be expedient or proper for the purpose of the scheme," and perhaps borrowing and other financial powers may be held to be covered by the words quoted. Also the scheme may provide for the exercise by the Joint Authority "of all or any of the powers of the authorised undertakers within the electricity district," which certainly seems to cover borrowing and other financial powers, including the borrowing powers of municipal undertakings on the security of the rates.

It seems, therefore, that any scheme approved or formulated by the Commissioners must incorporate provisions for financing the authority, with sufficient elasticity to allow for future development. This part of the scheme will not be the easiest to arrange.

To revert to procedure. When the Electricity Commissioners have approved or formulated a scheme, they are to publish it, and to hold a public inquiry on it. After that, they make an order giving effect to the scheme, possibly with modifications resulting from the last-named inquiry, present it to the Ministry of Transport, which may confirm the order, with or without modifications. The order has then to be laid before each House of Parliament, and is not to come into operation until it has been approved—with or without modification—by a resolution passed by each House. With these approvals the order giving effect to the scheme will have the validity of an Act of Parliament. It may be altered at any future date by an order which has passed through the same procedure.

It may be useful to recapitulate the steps of this procedure:—

1. Notice of provisional delimitation of electricity district by the Commissioners.

Objections or representations regarding the inclusion or exclusion of any area in the proposed district may be submitted, and if such are submitted the Commissioners have to hold a Local Inquiry No. 1.

2. Notice that it appears to the Commissioners that the organisation of supply in the district should be improved, and inviting authorised undertakers and certain other bodies to submit schemes for its improvement within a definite time.

The Commissioners have to hold a Local Inquiry No. 2 into this matter. At this inquiry questions of the inclusion or exclusion of any area in the district may be raised, whether Local Inquiry No. 1 has been held, or not, and it is only after No. 2 inquiry that the area is to be finally determined.

The Commissioners evidently consider that these two notices may be issued simultaneously.

3. Publication by the Commissioners of any scheme which they may have approved or formulated, and the holding of Local Inquiry No. 3 thereon.

4. Presentation by the Commissioners of an order giving effect to the scheme decided on as the result of Inquiry No. 3 to the Ministry of Transport.

5. Confirmation, with or without modification, of an order so presented, by the Ministry of Transport.

6. Approval by each House of Parliament by a resolution of an order so confirmed, with or without modification.

There will be opportunities for parties interested to present their case:—

1. As to the inclusion or exclusion of any area, by objection or representation, at Local Inquiry No. 1; and at Local Inquiry No. 2.

2. As to schemes for the improvement of supply, by the submission of such schemes, at Local Inquiry No. 2, and at Local Inquiry No. 3.

3. Generally by representations to the Ministry of Transport with respect to an order giving effect to any scheme, before the Ministry confirm it.

4. Generally, in discussion in Parliament on the resolution to confirm any order, if they can find a member of either or both Houses to put forward their views.

The Commissioners and the Ministry of Transport may make rules in relation to the various inquiries and other proceedings above summarised. Until these rules—which have to be laid before Parliament—have been made, nothing more definite can be said as to how action is to be taken under headings 1, 2 and 3. As to No. 4, there are no rules, but there are manners.

The Electrical Resistivity of Iron.—At the annual meeting of the Iron and Steel Institute, Mr. A. L. Norbury discussed the effect of various elements on the electrical resistivity of iron, and gave a *résumé* of the most important papers on the subject, up to and including that of Benedicks in 1902. He showed that Benedicks's method of plotting the resistivity values of quenched carbon steels on a straight line, and extrapolating to 7·6 microhms as the resistivity of pure iron, could not be considered correct. Recent determinations gave 9·9 microhms per centimetre cube as the resistivity of pure iron at 20°. The results obtained by recent investigators showed that equi-atomic quantities of different elements dissolved in iron did not increase the electrical resistivity to exactly the same amount. A new factor depending on the electronic properties of the particular element in solution determined the atomic resistivity increase in each case. The problem of calculating the electrical resistivity of a steel from its chemical composition was briefly discussed.

In a paper by Prof. C. A. Edwards and Mr. A. L. Norbury on the effect of heat treatment on electrical resistivity, it was stated that in the annealed condition the effect of chromium was to raise the resistivity of iron by 3·75 microhms for each 1·0 per cent. in excess of 4·3 times the carbon content. It appeared that the effect of chromium upon the resistivity of iron was to cause an increase of about 5·1 microhms per cubic centimetre for 1·0 per cent. held in solid solution.

THE ELECTRIC PROPULSION OF SHIPS.

By R. J. BUTLER, M.I.N.A.

(Abstract of paper read before the Greenock Association of Engineers and Shipbuilders.)

It is the purpose of this paper to consider some aspects of what appears to the author to be the logical outcome of the geared turbine for ship propulsion, namely, the substitution for the mechanical means of speed reduction of a method which shall be more in keeping with developments in the transmission of power in other industries, *i.e.*, an electrical one. In putting forward a proposition, no matter how great the technical merits of the scheme may be, it is necessary to offer the prospective buyer either a cheaper price or to produce indisputable evidence that an extra outlay will be more than recouped in a short period; and that definite advantages result from this increased initial expenditure. To the shipowner the cost per ton-mile of goods carried is the criterion by which his machinery is judged, always, of course, assuming reliability of the equipment.

In the original paper a list of the electrically-propelled vessels so far completed is given, besides which there have been six other installations completed, including three 3,000-h.p. set by Japanese firms, some smaller repeat vessels for Swedish owners, and some 40 vessels aggregating about 70,000 h.p., are under construction, principally for Scandinavian owners; all these sets are equipped with Ljungstrom type generators. It must be conceded that there is another side to the picture, and the principal objections levelled against the system are:—

1. Additional first cost. It may be stated broadly that the average increase of cost over, say, double mechanical reduction turbines should not exceed 20-25 per cent. for a tramp steamer of moderate size and diminishes with an increase of power.

2. Difficulties of cooling the generators and motors. This is a serious problem, as 5 to 6 per cent. of the total energy through the machines is dissipated in heat, but can be much assisted by intelligent grappling with the ventilation system. Sir Charles Parsons employed water to cool the rotors of generators some years ago, with very successful results. For marine propulsion the provision of cooling water to the stator also appears to be a very desirable object, and Mr. J. Shepherd has shown how this can be arranged.* Practically the whole of the heat so generated can be returned to the boiler. Further, the system would practically eliminate fire risks; at present a flash over is fed by the forced draught of the cooling air. It is realised that very careful construction would be necessary to obviate damage to the electrical parts by water leakage, but the system appears feasible, and, moreover, prevents deterioration and other troubles from salt air, which is extremely destructive when moist and warm.

3. Speed regulation and drop in motor efficiency. This cannot be strictly alleged as a disadvantage, and will be touched upon later.

4. The effect of helm on propelling motors running at synchronous speeds. In a twin screw vessel, when the helm is put over, the revolutions of one of the propellers show a large drop, depending on the direction of turning or, in other words, to keep up the revolutions requires a large increase of power. In the case of a.c. motors running at approximately synchronous speed, the effect of this is equivalent to an increase of propeller torque, and the motors must be designed to meet this virtual overload. Moreover, when going astern, full motor torque will be available, seeing that the synchronous speed will be maintained or nearly so. At the same time, induction motors could not lose their speed to the same extent as a steam turbine, without falling out, but trial results on the point are, as far as I know, not yet published. As an offset to this, if the load be removed, for example, by shedding a blade or breaking a shaft, the motor will not race.

5. The loss involved in transmission due to the inherent principle of converting mechanical into electrical energy and then back again to mechanical. Whilst it may be conceded that the loss is to some extent greater than with straight mechanical transmission, yet the disparity is very small, and is more than balanced by the advantages obtained. The average figure taken for single reduction gear loss is 2 per cent., and it has been common practice to assume 4 to 5 per cent. for double reduction gearing. This figure is, probably, too low, particularly at fractional loads. Some experiments carried out by the G.E. Co. of America showed an efficiency of 94½ per cent. for double reduction gearing, and a figure of 93 per cent. is attainable with the electric drive if properly designed. Bearing in mind that a considerable gain accrues from not having to drive an astern turbine whilst running ahead, 1½-2 per cent. should be about the difference involved. Further, mechanical gearing can hardly be expected to maintain its prime efficiency over a number of years of working.

It appears that the greatest scope for the system is in large vessels of the battleship and cruiser type where economy is vital at reduced powers and speeds and where the military and strategic aspects of the installation are unequalled by any other. Also in the case of high-powered mercantile vessels the system offers advantages in weight and space occupied. The case of small steamers of the tramp type is not so attractive, although the steam and fuel consumption of vessels tried out is certainly excellent. In the case of the *Wulsty Castle*,* the results of three long voyages come out at 1.05 lb. of coal of poor quality per i.h.p.-hour for all propelling purposes, which is some 9-10 tons better per day than a reciprocater of the same size. This, together with the increased cargo capacity attainable by placing the motors aft, the most prominent feature.

One of the objections urged against electrical driving is that it involves the carrying of skilled electrical as well as steam engineers. All engineers, if worthy of the name, have at least a smattering of electrical knowledge, and provided the gear be made of the simplest character and as fool proof as possible, and of the same general nature as is already found on ships, it is submitted that this argument does not carry a great deal of weight.

As regards reversibility, the writer himself saw the ease with which this was done on the *Wulsty Castle*, the average time being 7 seconds ahead to astern, whilst the *New Mexico*† is stated to take from 7 to 9 seconds for the same operation. The turbines can also be started from cold in about 12 minutes, a vast difference from the old lengthy period of warming up.

D.C. is neither technically nor commercially a sound proposition for any but the smallest installations. The limitation of pressure means that very high current densities must be carried, and the size of the cables, commutators, brush gear, and windings becomes so large as to make the expense prohibitive. Moreover, large commutators and brush gear limit again the speed of the prime movers, so that, unless mechanical gearing is introduced, the turbine speed necessary is not the most economical one, and the turbine is itself of increased size, due to the restricted rate of revolution. With large commutators, moreover, a flash over might possibly stop the ship. These considerations, together with the heavy upkeep of commutators and brushes, have ruled out the D.C. machine for all but submarines, where current is supplied from storage batteries. All other installations have employed A.C. to date.

The main turbo generators will not differ largely from land practice, until the advent of water cooling mentioned earlier; they are usually of the 3-phase bipolar type with, in small machines, an integral type exciter, and in large sets with separate source of supply for this purpose. The number of turbines should, in any case, be two, and in all installations so far no stand-by generator has been provided, but both generators operate in parallel. In the case of the *New Mexico* the machines are of two-phase design, but this is the only example of the type I am aware of. The voltage at which the machines work is partially determined by the method of driving auxiliaries, but in practice the pressure has been increasing up to 4,242 volts in the *New Mexico*; 3,000 volts would appear to be the most suitable figure, giving moderate size cables, but there seems to be no reason why, in the future on large vessels, pressures of 6,600 volts or even higher should not be employed.

The turbines should be arranged for as high a superheat as is possible without unduly affecting the economy of the steam generators, so as to take every advantage of the absence of an astern turbine, and it is in this respect that the Ljungstrom type with its known capability of standing any practicable temperature without distortion is so satisfactory, irrespective of its high economy.

The vacuum should be as high as is obtainable compatible with the sea temperature conditions of the waters traded in and provided that the power expended in obtaining it does not neutralise the gain in efficiency.

In designing both the generators and motors, it must be borne in mind that a large overload torque is necessary to pull up the ship when going full ahead and then suddenly reversed. In the case of the *New Mexico*, this condition was met by temporary over-excitation of the generator fields, a booster being put in for this purpose. As this overload only occurs for a very short period, and is automatically cut out, there is no danger of overheating, and the generators can be designed for normal load, if provision for this condition is made. The main motors can be either of the squirrel cage or slip ring type.

If motors of the squirrel cage type are desired, the rotor conductors must be specially arranged so as to provide the characteristic of starting on load, which the ordinary squirrel-cage motor will not do. In the *New Mexico* the rotors are provided with inner and outer conductors, one of high

* Elec. Rev., January 16th, 1920, *et seq.*

* Elec. Rev., May 17th, 1918.

† Elec. Rev., May 10th, 1918.

resistance and one of low resistance with a deep air gap between the windings; this, however, is the only modern example of this method. The advantages thereof are so great, viz., it eliminates the necessity of fitting liquid resistance in the circuit, that it is thought the scheme will be more generally adopted. In the case of other vessels, the slip-ring type of motor is used with liquid variable resistances in the circuit for providing the necessary starting torque. If two economical speeds are required double windings on the motors will be provided, but this should only be necessary in the case of battleships, and will not, of course, be required in the case of mechant steamers running at constant speed, for which the motors can be wound of the ordinary induction type. In some cases of high power and low propeller revolutions, it may be necessary to insert a helical gear reduction between the motors and the shaft, but this should be avoided if at all possible.

Speed regulation is at present accomplished by: (*a*) Changing the speed of the turbine, *i.e.*, altering the periodicity and voltage. (*b*) Insertion of resistances. (*c*) Change of voltage without change of generator speed. (*a*) and (*b*) are the usual methods in modern ships, and can be done readily on all A.C. installations. In ordinary land practice, the revolutions are maintained constant with change of load and steam consumptions of turbo-alternators are given by makers at full and fractional loads with the speed constant. This condition does not apply at sea, the revolutions being a function of the ship's speed required to overcome the resistance to movement through the water. Information concerning alternator and motor efficiency under these conditions is practically impossible to obtain. In this connection, when the *New Mexico* was built a propeller model was made and the torque and speed plotted; the motors were then designed from the information so obtained, one of the figures obtained being the overload torque on rapid reversal already discussed. In most cases, it is to be presumed, the motors have been made of amply large size, without elaborate investigation, and the appearance of existing sets goes to confirm this supposition.

Much yet remains to be done in the evolution of the control gear suitable for use on shipboard, where the conditions are so very different from those obtaining in power stations. Great care in the design and fitting up of all switchgear, instruments, &c., must be exercised to exclude wet salt air, and sometimes coal dust. The provision for running cables where out of reach, but readily accessible for examination, must be very carefully considered, and they should be placed in positions where there is no danger of flooding; particularly should they be kept out of bilges.

The Diesel engine is now rapidly overcoming prejudice and gaining the confidence of shipowners, and for reasonably low powers, say, up to 3,000 B.H.P., is a powerful rival to the steam equipment.

The disadvantages of the lack of experience of builders leading to breakdown at sea; the weight of machinery per B.H.P. developed, and the comparatively high price of the equipment compared with steam plant, are being steadily reduced, and the day appears not far distant when the two systems will have drawn level on all three scores.

The average consumption of ½ lb. of oil per B.H.P.-hr. cannot be approached by steam, although the consumption of lubricating oil to some extent offsets the saving in running costs. With direct-connected Diesel engines, where the speed of rotation is moderately low, say, 125 for 1,000 B.H.P., the weight heretofore has been excessive, and should higher speeds be adopted with a view to cutting weight and price, a diminished propeller efficiency results. Mechanical gear has been fitted in one or two recent American vessels, with apparently successful results, but the insertion of an electrical reduction appears preferable, in that it abolishes the great bugbear of starting and reversing the Diesel engine. The maximum speed of, say, 500 R.P.M., corresponding to highest submarine practice, is eminently suitable for D.C. generation so that in this respect D.C. generators and Diesel engines approach their maximum suitable power and speed together. It is doubtful, however, if this fast-running type will ever prove to have the necessary reliability, which it must have in the rough and tumble of commercial work; submarine engines being notoriously of a kind that require much nursing and tuning up.

It will be seen, then, that the Diesel electric combination drive has not the attractions of a turbo-electric drive, where both turbine and alternator essentially need high speed for operating at maximum efficiency. It should be added that no electrical difficulty should arise, except that overload conditions cannot be met so readily as in the turbo-driven plant, especially when the boilers are oil fired.

Turning now to a consideration of the auxiliary machinery, an enormous saving of fuel consumption results from the ability to drive these electrically, at a cost of, say, 15 lb. of steam per H.P.-hr. (including all losses), against some 40 lb. (a very conservative figure) for the direct steam-driven machines. It will be noted that the source of supply of exhaust steam for feed heating is removed, but as shown above, either the water-cooled alternators themselves can be arranged as feed heaters, or if cooling air is adhered to, a supply of low-pressure steam can be bled from the turbines at a stage where the pressure is appropriate. The absence of auxiliary steam and exhaust pipes, with their accompanying radiation losses, is a source of further economy, and relieves space congestion.

It has always appeared remarkable that the electric driving of auxiliaries in ordinary vessels, with an internal combustion engine generator, has not appealed to superintending engineers as a fuel-saving proposition of high merit. It remains to be discussed whether the auxiliary plant motors should be D.C. or A.C., and at what voltage. These are questions which must be dealt with on the merits of each specific case. In the first place, in a small vessel, where the percentage of auxiliary power to propelling power is high, the demand for energy in harbour will be the determining factor, and it would probably pay to run one of the main generators (there should never be less than two installed) at reduced load, rather than fit a separate unit for auxiliary purposes.

In larger ships where the power required for auxiliary purposes is fairly considerable, but a small percentage of that of one of the main generators, it would pay to install one or more machines solely for this purpose, and if the auxiliaries are to be run with D.C. motors, these supplementary sets may be arranged to excite the main fields also, with, of course, provision for regulating independently.

In any case, we are confronted with fitting the auxiliary motors to take a supply either: (*a*) A.C. direct at voltage of the main or auxiliary generator. (*b*) A.C. at reduced voltage through static transformers, either from main or auxiliary sets. (*c*) D.C. at reduced voltage through a motor converter, either from main or auxiliary sets. (*d*) D.C. at any desired voltage direct from separate D.C. machines.

(*a*) Unless the propelling power is very small, the generator voltage will not be sufficiently low to enable it to be used on the corresponding small A.C. motors direct. Moreover, high-voltage A.C. motors of small H.P. are difficult to build and maintain, have not very flexible characteristics, nor in the case of a breakdown can they be readily repaired or replaced from stock, unless the voltage and periodicity are the standard of the country in which the ship happens to be. This system is fitted in the *Wulsty Castle*, but has little except simplicity to recommend it; in this case the voltage is 650 and periodicity 60, which voltage is not a standard in any country.

(*b*) This is a more satisfactory method. The periodicity question still holds here, and in both cases (*a*) and (*b*) when annual survey is being carried out and all steam raising plant is out of operation, it is very unlikely that the shore supply would be of the same voltage and frequency as that provided on board.

The control of small motors, *e.g.*, for air and circulating pumps, where flexibility is such a desideratum, is not so readily effected with A.C. motors, so that whilst (*b*) is superior to method (*a*), (*c*) appeals to me as readily meeting all the conditions. As far as is known the system is not yet fitted in any ship, and it suffers from the introduction of another moving link in the chain, and whilst the efficiency of the converter is not so high, nor is it so cheap as the static transformer, yet seeing that the auxiliary current will usually be some 6-8 per cent. of the main, the loss of economy will not be serious, and there are very great advantages to be derived from its employment.

Method (*d*) is that fitted in the American battleships, and fulfils the same requirements as (*c*). Two 300-KW. sets of which 60 KW. are used for exciting, are fitted, and their exhaust is led either to the feed heater or main turbines.

So far as weight and fuel consumption are concerned, there appears on paper very little to choose between the rival electric and mechanical double reduction gears, but reliable consumption data for the double reduction gear drive are not yet to hand, and such figures as have been quoted certainly do not bear out the glowing estimates which have been made.

In the opinion of the writer, the system of electrically-propelling ships has come to stay, particularly for large high-powered vessels. The Scandinavian nations and the U.S.A. are going ahead vigorously. Unfortunately the war dislocated all the British plans, but a revival should appear in the near future.

National Health Insurance.—The Ministry of Health makes the following announcement:—

The National Health Insurance Bill, which has just received the Royal Assent, makes important changes in the benefits and contributions under the National Health Insurance Scheme, to operate from July 5th next.

The object of the changes is to provide for an increase in the rates of benefit in view of the fall in the value of money. The normal rate of sickness benefit will be raised from 10s. to 15s. a week in the case of men, and from 7s. 6d. to 12s. in the case of women; disablement benefit will be raised from 5s. a week to 7s. 6d. for both men and women; and the amount of maternity benefit will be raised from 30s. to 40s.

In order to provide for the increase of benefits, the joint weekly contribution is to be increased from 7d. to 10d. in the case of men and from 6d. to 9d. in the case of women, of which the employer's portion will normally be 5d. in each case. In certain cases where low wages are paid the employer will pay a larger, and the worker a smaller, portion of the joint contribution. The contribution cards from the week beginning July 5th next must in all cases be stamped at the rate of 10d. a week for men and 9d. for women; stamps of these values will be on sale at post offices.

A NEW TYPE OF SHIPYARD CRANE.

By W. HOK.

(*Abstract of paper read before the* Institution of Engineers and Shipbuilders in Scotland.)

Some eight years ago it was decided by the Lindholmen Shipbuilding and Engineering Co., of Gothenburg, to lay down three new berths for the construction of ships up to 12,000 tons deadweight. It became imperative to decide what kind of hoisting appliances should be adopted for the new berths, and in 1913 I set out to visit about 40 shipyards. I found that a large number of very efficient yards adhered to the ordinary mast and derrick arrangement. Invariably the hoisting winch, whether steam or electric, common to two or more derricks, was placed on the ground level, with the attendant trouble of having the hoisting rope leading from the winch to the derrick mast always entangled in bars and plates, staging uprights, and all sorts of rubbish. Besides, signal men placed here and there were part of this equipment, as the winch operator could not as a rule see what he was doing. Other yards were equipped with all kinds of expensive overhead travelling cranes, cantilever cranes, and revolving cranes.

Nobody seemed entirely satisfied with the crane arrangements he possessed. On the whole the tendency was to discard very expensive crane sheds, covered in or not, and to substitute cheaper arrangements.

I came to the following broad conclusions:—

1. The mast and derrick arrangement is quite satisfactory, provided it can be so arranged that all side staying of masts can be done away with.

2. The operator's platform should be placed high up above the ground so that the operator can see what he is doing, thus obviating the necessity of using signal men.

3. The lead from the hoisting winch to the derrick mast should be free from all obstructions.

4. A space or passage-way is desirable between contiguous ships to enable building material to be brought down between

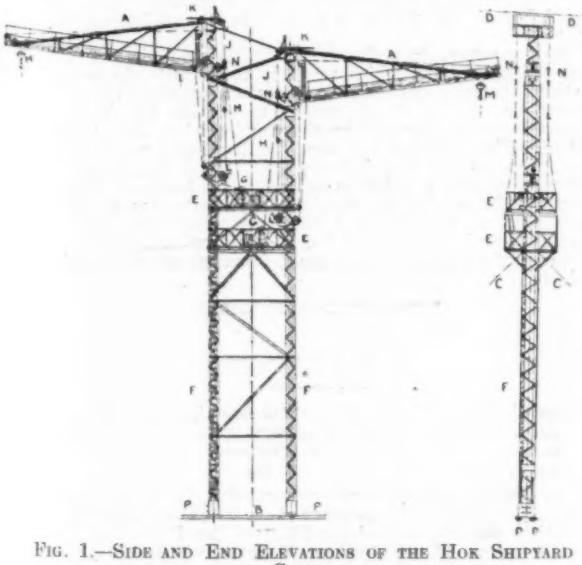


Fig. 1.—Side and End Elevations of the Hok Shipyard Crane.

ships and hoisted on board from the nearest point at the ship's side, and not from the ship's end only.

Guided by the leading features just mentioned, I designed the stationary building-berth crane here illustrated, eight of which are erected at the Lindholmen Works, and have been in good use since 1914.

It will be seen that the new type of berth crane is chiefly composed of a stationary main structure and two swinging arms, the former consisting of two lattice-work masts placed about 15 ft. 3 in. apart from centre to centre, and rigidly connected to one another by cross stays and trusses, making the main structure stable in the thwartship direction, thus obviating the necessity of fitting the objectionable side-stays which are an inevitable essential of the ordinary mast and derrick arrangement.

Each derrick frame carries two derricks or arms A, fig. 1, as shown, which can swing about 120 degrees to each side of a vertical thwartship plane through the derrick frame, *i.e.*, well past the centre line of railway B, laid down in the passage-way between contiguous ships. The derrick frame is held in place by fore and aft wire stays only, as shown in figs. 1 and 2, *i.e.*, by two sets of stays, the lower ones C being fitted, partly for giving rigidity to the frames in a fore and aft direction, partly for preventing collapse of a whole group of interconnected cranes in case for some reason the top end stays B, fig. 2, or some of the top stays D, figs. 1 and 2, fitted from crane top to crane top of that group should give way.

At a suitable place above the ground two operators' or winch platforms E, are built into the derrick frame, one above the other, access to which is obtained by ladders inside the frame legs F.

Each crane arm and the load are in the present case controlled from their appropriate platform E by a single ordinary A.C. electric shipyard-winch G, that is to say, controlled by one electric motor only. Hoisting and lowering are done with the winch centre barrel in the ordinary way, and slewing with the extended winch ends by taking a couple of turns round the appropriate extended winch end with the loose end of a tackle H, actuating the wire J which is carried round and fastened to the rim of the horizontal wheel K on top of the crane. The wheel is fixed to the top centre pin of the crane arm.

A spiral spring N is introduced above the slewing tackle for the purpose of taking up the inertia of the crane arm when it arrives at the extreme end of the swing, in this way preventing damage and unnecessary straining of the connections in case of rough usage or ignorance on the part of the man handling the crane; for the crane is so easy to manipulate that any ordinary platers' helper or labourer can officiate.

Racking is done with a small hand winch L. It will be noticed that the lower member of the arm along which the trolley moves is not horizontal, but slightly sloping. It is in this case purposely so arranged in order to make it comparatively easy to move the trolley towards the outer point of the arm, when there is no weight on the crane hook, and to make it very easy to move the trolley towards the derrick frame when the load is on; and for these reasons the trolley M is always moved, before the weight is on, as far out towards the extreme end of the arm as considered necessary in each individual case, after which it is a very simple matter to adjust the trolley in the direction of the derrick frame, if necessary, after the load is on. In practice this method has shown itself to be satisfactory and quite sufficient. If it should be preferred to manipulate the crane with three motors, one for hoisting, one for slewing, and one for racking (the member on which the trolley travels being in that case horizontal); it can, of course, be easily done.

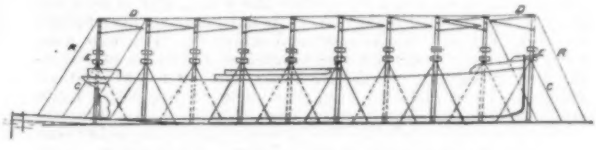


Fig. 2.—Berth Equipped with Cranes.

The frame legs stand on joists P, laid thwartship, and about 3 ft. apart—*i.e.*, the fore and aft dimension of the frame legs apart. These two joists are securely fixed to the solid rock, and the frame legs are securely bolted to the upper flanges of the joists. In this way is the transverse stability of the crane doubly secured.

The present cranes were built flat on the ground. When the arms had been fitted on to the frames and secured, the cranes were raised into a vertical position, and then screw-jacked into their absolute position. The frames have a height above the ground of 110 ft.; the section of each frame leg is 22 in. wide and 36 in. in a fore and aft direction. The crane arms are about 40 ft. long; the upper winch platform is about 60 ft. above the ground, the lower platform about 8 ft. below the upper one, and the height from the ground to the underside of crane hook in its highest position is about 90 ft. Ball bearings are fitted throughout. The clear distance between the frame legs is 13 ft. 6 in., thus admitting one or perhaps even two parallel railways between the frame legs and between contiguous ships. With these cranes 22 ft. only are required between contiguous hulls.

They were built to lift 2½ tons at the extreme end of the arm, but it was found that with a slight strengthening they could be made to lift 5 tons at the extreme end of the arm and 10 tons at about 10 ft. from the derrick frame.

One or both groups of cranes surrounding a ship can be shifted sideways without great difficulty.

Each crane, including one complete frame and two arms, but excluding winches and hoisting wire, weighs about 33 tons. These cranes are cheaper than any other existing hoisting appliance with the exception of the ordinary mast and derrick arrangement.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION'S DINNER.

ON Thursday last week the annual dinner of the Association was held at the Savoy Hotel. The Right Hon. Lord Ampthill, G.C.S.I., President of the Association, was in the chair, and there was a very large attendance, some 400 members and guests being present. Amongst the guests were Sir J. Fortescue Flannery, M.P., Mr. George Balfour, M.P., Sir John Wormald, C.B.E., Mr. C. Hamilton Wickes, C.B.E., Lord Carmichael, G.C.S.I., Sir John Snell, Lord Vaux of Harrowden, Engineer Vice-Admiral Sir George Goodwin, K.C.B., Rear-Admiral F. L. Field, C.B., Lord Ashfield, Lieut.-Col. Sir J. Dunlop Smith, K.C.S.I., Lord Sydenham, G.C.S.I., Mr. Andrew Fisher, Sir John A. Aspinall, Mr. James Swinburne, F.R.S., Mr. Roger T. Smith, President I.E.E., Sir Allan Smith, K.B.E., M.P., Sir Richard Redmayne, K.C.B., Sir J. E. Petavel, K.B.E., Sir Philip Nash, K.C.M.G., Sir William Clark, K.C.S.I., Mr. W. W. Lackie, Sir Harry Haward, Mr. C. H. Wordingham, C.B.E., Sir Frank H. Heath, K.C.B., Mr. G. Scott Ram, Mr. Archibald Page, Mr. C. Le Maistre, C.B.E., Mr. P. F. Rowell, Mr. Summers Hunter, C.B.E., Lieut.-Col. Mervyn O'Gorman, Mr. Michael Longridge, C.B.E., Mr. S. L. Pearce, C.B.E., Sir Thomas Robinson, C.B.E., M.P., and many other well-known engineers and leaders of industry.

Proposing "The King," the CHAIRMAN described him as the keystone of the arch of the constitution, and the bond of Empire, and eulogised his high qualities; he also drew attention, when introducing the following toast, to the splendid work of the Prince of Wales.

SIR JOHN SNELL proposed "The Industry," remarking that since 1916 no fewer than seven departmental committees had been appointed, on six of which he had served. The Electrical Trades Committee under Sir Charles Parsons showed that electricity was a key industry; combination at home was essential to successful competition abroad. The Electricity Supply Committee gave rise to the Electricity Supply Act, which was regarded on all hands as the great charter of electricity. The Coal Conservation and Water-Power Resources Committees showed how the national stores of energy could be better utilised, and the Committee on Electroculture had shown that an increased yield of 30 to 40 per cent. of grain and straw was obtainable. These committees, together with those on Imperial Wireless Communication and the Electrification of Railways, covered the whole gamut of electrical enterprise, and their work would bring about an era of prosperity in the electrical world such as had never been dreamt of in the old days. The output of energy from British electricity works rose from 1,300,000,000 units in 1913 to 4,500,000,000 units in 1919; five years of war had shown what an essential necessity electricity supply was, and in the next five years the output would be more than doubled again. The accompanying increased output of plant would bring improved methods of manufacture and lower the costs, besides developing export trade, and he predicted in ten years an unimagined prosperity for the whole electrical industry. He was glad to see that the Association was promoting the cause of education and research; we should train our own water-power engineers, for if the designing was done at home the trade would be kept at home—as a rule work followed the engineer. He was grateful to the Government for the colleagues given him as Electricity Commissioners. So far they were an extremely harmonious and hard-working body. No one could realise the immense amount of work that had accumulated; they had to perform all the electrical duties of the L.G.B., Board of Trade, L.C.C., &c., and in addition they had to develop their new procedure, bring the electricity regulations up to date (they were rather behind the times), study the whole country, and divide it into districts, promote new legislation, and deal with an immense number of extensions of plant. They had got under way with some celerity—the first district was published two weeks ago, the next was about to issue—but the industry must be patient till they had overcome the accumulation of five years. They had no idea of sweeping away all the existing stations and substituting 16 new ones, as the lay Press had it; they would weed out the bad ones, improve others, and add large complementary ones as required to meet industrial needs.

Sir C. ELLIS (Vice-president), in his reply, emphasised the importance of education and the provision of scholarships.

Mr. W. L. HICHENS proposed "The Profession," describing consulting engineers as the watch-dogs who prevented undue inflation of prices, and thereby benefited the industry, for it was important to keep prices low in order to retain the export trade. The Research Committee of the Association, he said, was doing excellent work, but every business should do some research of its own, and that was the soundest argument in support of the big amalgamations that had been taking place. The industry should also support research work at the universities more generously. He paid a tribute of admiration to the work of Mr. A. P. M. Fleming and his committee, which had produced a report on engineering training which everyone ought to read. They needed also a research into the ultimate aims of industry. Was it to amass private riches, or to produce the maximum wealth for the benefit of the community, or was it to promote the glory of God and the advancement of humanity? The root cause of industrial unrest was that they had no common ideal; co-operation was essential to the country's progress, but how could they expect it without an ideal?

Mr. ROGER T. SMITH, President I.E.E., replied, and pointed out that the war made it clear that science and research were the mainsprings of electrical industry. Only production was required in addition. The industrial engineer and the consulting engineer were of equal merit; the Institution of Electrical Engineers had for many years ceased to be a professional institution, and sought to represent every section of the industry, none more than the manufacturers' section. Their association, in connection with the Department of Scientific and Industrial Research, was a most important step; the Association and the Institution were also jointly represented on the Committees of the British Engineering Standards Association, whose specifications were a form of "protection" to which no party could take exception, and ought to become national standards.

Mr. JAMES SWINBURNE also replied, putting in a strong plea on behalf of the salaried members of the industry. He accused the Government of blank ignorance of the fundamental principles of the currency problem; it first debased the currency to half its pre-war value, and then, when an engineer was paid at double the pre-war rate to compensate for this, it took away one-third of his income by taxation. People had little idea how badly off the unfortunate salaried man was; let those who were in control of salaries realise that the Bradbury was only worth half a sovereign, if as much as that.

The CHAIRMAN proposed "The Guests," remarking upon the happy relations which prevailed between the buyers and sellers at that table.

Rear-Admiral F. L. FIELD, in reply, said that nothing had increased so rapidly in the Navy in the last few years as electrical plant. The Navy was now to be reduced, but he maintained that the smaller it was, the more perfect the material must be, and they must spend more money on research than ever before.

Sir ALLAN SMITH also replied, remarking that as the industry had survived seven committees, he was confident in its ability to continue to prosper.

Mr. W. O. SMITH (Chairman of Council), proposing "The Chairman," said that the absence of Lord Ampthill on military service for five years had been a serious loss to the B.E.A.M.A., but during the war their membership had doubled.

The CHAIRMAN, in reply, expressed his pride in presiding over the Association, which was helping to "win the peace." National security depended on economic security, which involved the ability of the nation to provide for itself all essential commodities without dependence on any foreign nation. The electrical industry, the handmaid to all other industries, was a key industry—and the B.E.A.M.A. was going to see that that key remained in the hands of Britain.

During the evening the band of H.M. Scots Guards played a programme of music, and all the arrangements were admirably conceived and carried out. The gathering will rank as one of the most important social functions of the electrical industry.

REVIEWS.

Telephonic Transmission, Theoretical and Applied. By J. G. HILL, Assistant Staff Engineer, General Post Office, London. Pp. xvi+398, 196 diagrams. London: Longmans, Green & Co. Price 21s. net.

This volume on telephonic transmission is the first of a series of manuals on telegraph and telephone engineering edited by the late Engineer-in-Chief of the Post Office, and now in course of preparation. If those which are yet to appear are analogous to the present one in their general structure and method of treatment, we shall be provided with material which will be of immense service to all telegraph and telephone engineers in everything appertaining to the lines and apparatus with which they have to deal.

Following a plan which a number of recent writers of text books involving somewhat advanced mathematics have adopted, the author gives a preliminary chapter to a statement of the more important formulæ which are brought into use throughout the book. This chapter will be particularly helpful to the student by the clearness with which the structure of the various formulæ, particularly those of hyperbolic functions is arrived at, although it is to be feared that the reader whose knowledge is confined to algebra up to the theory of indices, and a knowledge of ordinary trigonometrical formulæ, will have some difficulty in recognising $e^{jx}=\cos x + j \sin x$ as de Moivre's theorem.

The succeeding thirteen chapters deal with the "infinite" line and equivalent circuit, the loading and design of cables (all from the direct current standpoint), the human voice in telephony, application of alternating currents to lines, reflection and power in telephone circuits, the constants of telephone circuits, the loading of circuits, measurements on transmission lines, the standard cable and its uses, cost problems in transmission, transmission formulæ for lines in

series with apparatus in series and in leak, and the thermionic valve as a telephone relay. It will thus be seen that Mr. Hill covers a wide field in his treatment of the subject.

The student, however, will find it necessary, before commencing a serious study of the transmission problems to thoroughly acquaint himself with the mathematical proofs given in the appendices at the end of the volume, having done which he will be in a position to follow the mathematical portions of the book. These portions are more or less restatements of the work done by the pioneers in the subject, along with their application, in illustrative examples, to present-day problems.

In Chapter IX the author deals with the loading of telephone circuits comprising overhead, underground, and submarine lines, and the three types of loading, viz., continuous, series, and leak. Much useful information is given on this extremely important branch of telephonic transmission which has contributed so largely to the extension of the limits over which ordinary commercial speech was practicable. Not only has Mr. Hill dealt exhaustively with the advantages incidental to the several types of loading, but he also enumerates the disadvantages which may likewise be operative, *e.g.*, in the case of continuous loading, the limitations of the method are set forth seriatim. It would be interesting to know, in this connection, if the unequal ageing of the iron windings is still a possible objection to the method or whether it has been borne out by actual experience.

Chapter X is a particularly useful one, inasmuch as it is devoted to the measurement of impedance, and line constants; worked examples being freely interspersed in the text. A full description of the Franke machine, and its application to impedance measurements, is also given. An interesting account follows of the W.E. Co.'s cross-talk meter, and the method of using it in the estimation of cross talk from any disturbing source.

Not the least interesting chapter in the book is that dealing with cost problems in telephonic transmission, and here the author has not confined himself to purely academic statements or generalities. Starting from the electrical constants of some specific type of line, the equations of cost are built up, and curves are given which embody the results arrived at.

The final chapter is appropriately devoted to the latest development in the field of practical telephony, viz., the thermionic valve and its use as a telephone relay. Many attempts have been made since the telephone became a commercial success to introduce repeating devices, such as in the case of the telegraph, that would enable signals to be repeated at one or more points, and hence extend the limit to which it was possible to communicate; but all have proved more or less unsatisfactory. With the advent of the thermionic valve, however, new possibilities suggested themselves, and telephone engineers were not slow to avail themselves of the solution of a problem that had so long baffled them, which the valve offered them. Much good work has been done in the application of the valve amplifier as a telephone relay by the British Post Office; and although finality cannot be said to have been reached, even with Mr. Hill's anticipated 27 miles of standard cable improvement, we are nevertheless in possession of an agent which has given an entirely new trend to the efforts of those who are dealing with long-distance telephony, and which in its revolutionary aspect, as regards existing means of communication, appears to be fraught with far-reaching consequences.

In seven appendices are given the mathematical proofs of the formulæ employed throughout, and an eighth appendix shows graphically the relation between x and ϵ^{-x} from $x=0$ to $x=13.8$, and from $\epsilon^{-x}=1$ to $\epsilon^{-x}=1\times10^{-6}$ which will be found useful.

The book appears to be extremely free from typographical errors, but attention is drawn to page 166, fourth line from bottom, where "171 miles" should read "171 mils"; and on page 224, eleventh line from top, the final "d" of "designed" is inverted.

We expect that this volume will have a wide circulation, not only for its own intrinsic merits but because it is the production of one who has already done so much careful and extensive work in the field of telephonic transmission; and if the remaining volumes of the series promised by Messrs. Longmans are at all similar to the present one, in so far as letterpress and illustrations are concerned, little will have been left to be desired. A. F.

Guide to the Study of the Ionic Valve. By W. D. Owen, A.M.I.E.E. London: Sir Isaac Pitman & Sons. Pp. vii +58. Price 2s. 6d. net.

At a time when technical education is of such paramount importance, every new publication which will increase popular knowledge in the accomplishments of science has its value. During the war, the progress of wireless telegraphy was very rapid, and, owing to the conditions, the general public and the amateurs interested in wireless have had little opportunity of studying the new advances. The result is that there is now a general thirst for knowledge. That it helps to supply this knowledge to a slight extent appears to be the only excuse for the publication of this booklet.

The price of the book seems rather high for about fifty small pages of large type. There are fifteen chapters, each of them very elementary and discursive. The first contains the statement that "the assumption that electricity travels from positive to negative is incorrect." This sweeping assertion in capital letters is likely to give the elementary reader an unnecessarily rude shock, especially since no real explanation is given for the dramatic statement.

On page 11, after discussing the Fleming valve as a hot-to-cold electrode rectifier, the reader is directed to fig. 3. A plate battery, however, is shown in this figure, and the beginner for whom the book is written will undoubtedly wonder what object it serves. It is only later that rectification due to non-linear plate current variation is explained.

No mention is made of rectification at the saturation bend of the curve.

Referring to the use of a grid, the author states that "the additional electrode must be such as to have capacity with respect to the filament." As a matter of fact, the smaller the capacity of the grid the less will be the energy required to charge it to a given potential. It is an advantage to have the grid capacity as small as possible.

In chapter VII the author opens his remarks by an extraordinary demonstration of the principle of the valve as an amplifier. Two lines are drawn, one a steep one representing the straight portion of the grid voltage-plate current curve of a 3-electrode valve, and the other a straight line at 45 deg. representing Ohm's equation C=E/R. The explanation is that the valve "curve," being steeper, gives an amplifying effect. It is hoped that the reader will realise that the slope of the C=E/R curve depends merely on the value of the R chosen. In any case, it is not possible to compare the result of Ohm's law with the effect of voltage in one circuit on current in another.

On page 39 the author tells his readers that the various types of tubes now used vary intentionally in degrees of vacuum. With the exception of admittedly soft valves, every attempt is made to exhaust valves to the highest possible degree in all cases.

The second half of the booklet contains practically no information, but is a hurried attempt to say *something* about each of the different applications of the valve. If published in 1917, the book might have been of some slight use, but now, when so much more complete information has been published in book form, there seems no need for a sketchy introduction to the subject.—JOHN SCOTT-TAGGART.

Diesel Engine Design. By H. F. P. PURDAY. London: Constable & Co. Pp. xiii+301, 271 figs. 1919. Price 21s. net.

This book, based on 12 years' experience of Diesel engines, mainly from the drawing office point of view, presents an account of the main considerations which control the design of these engines.

The design of Diesel engines is now long past the rule-of-thumb stage; designers have agreed on many fundamental principles and general ideas of construction, and these same principles are not likely to be greatly changed. It is now possible to compute with accuracy the various stresses occurring in the component parts, and results can be foretold almost as closely as with the steam engine and turbine.

The progress made in the manufacture of Diesel engines can be seen from the fact that one foreign firm has built over 30 sets with an average indicated horse-power of 2,700, and is now building sets of engines up to 8,000 indicated horse-power, also one English firm is constructing four-cycle engines having an indicated horse-power of 6,600, which are proving a great success.

The first two chapters of the book deal with first principles and thermal efficiency. These provide a useful introduction to engine design and detail, and will be read with advantage by the student and engineering draughtsman.

Exhaust, suction and scavenge are dealt with very thoroughly, and the methods used in calculating areas are fully shown.

The principle of similitude, a very important subject when considering new types of engines, is dealt with in Chapter IV. The figures and tables given are based on a practical knowledge of modern engine design, and are very reliable.

Chapter V deals with crank shafts, and a considerable amount of space is devoted to the arrangement of cranks, order of firing, proportions of journals, twisting moments, and lubrication.

The design of fly wheels, and their application to Diesel engines, is fully considered, and a large number of examples are worked out.

Framework, design of cylinders and cylinder covers, and running gear are all dealt with in a very able manner, and fully illustrated.

A description of the various fuel oil systems, both as regards the storage tanks and piping which are external to the engine, and the organs of the engine itself which are directly concerned with the delivery of the fuel to the working cylinder, is given and illustrated with useful line drawings.

Air and exhaust systems and valve gears are dealt with at the end of the book.

Mr. Purday's book is an extremely valuable and practical contribution to the literature on the Diesel engine; it is a pleasure to read, and can be strongly recommended to both students and designers for its completeness, conciseness, and

intelligent selection of examples and illustrations. The whole book points to a thorough practical knowledge of the subject. The reference to literature (authors and publishers) which is inserted at the end of each chapter is to be commended.

E. P.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,812. "Dynamo-electric generators for lighting cycles, &c." A. BEVITT and W. A. HYMAS. May 8th.

12,819. "Circuit-controllers for internal-combustion engines." G. FUEGEL and H. SCHMID. May 8th. (United States, July 18th, 1917.)

12,820. "Magnetos for internal-combustion engines." G. FUEGEL and H. SCHMID. May 8th. (United States, July 18th, 1917.)

12,831. "Apparatus for rectifying high and low frequency alternating currents." J. NIENHOLD. May 8th. (Germany, May 15th, 1917.)

12,833. "Positive electrodes for electric accumulators." A. POUCHAIN. May 8th.

12,834. "Electric accumulators." A. POUCHAIN. May 8th.

12,835. "Rectifiers of alternating currents." NAAMLOOZE VENOOTSCHAP PHILIPS' GLOEILAMPENFABRIEKEN. May 8th. (Holland, December 2nd, 1919.)

12,868. "Secondary or storage batteries." R. C. HOUSTON. May 10th.

12,871. "Device for testing electric ignition plugs of internal-combustion engines." T. MARSHALL and J. MURTAGH. May 10th.

12,879. "Apparatus for testing sparking plugs and induction coils." F. H. CLEGG. May 10th.

12,909. "Selector apparatus for automatic, &c., telephone system." T. LENAGHAN. May 10th.

12,929. "Means for measuring voltage variation in electric circuits." T. H. HARRIS. May 10th.

12,931. "Producing alternating currents." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 10th.

12,934. "Apparatus for electrical transmission of power." J. H. McKENZIE and A. H. SPROULE. May 10th.

12,935. "Variable electrical resistance." J. H. McKENZIE and A. H. SPROULE. May 10th.

12,939. "Positive electrodes of electric accumulators." A. POUCHAIN. May 10th.

12,940. "Primary electric battery." A. POUCHAIN. May 10th.

12,943. "Electrical connectors." WESTERN ELECTRIC Co. May 10th. (France, August 16th, 1918.)

12,945. "Telegraph cables." H. W. SULLIVAN. May 10th.

12,947. "Electric glow discharge lamps." H. FILIPPO, D. LELY and NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPEN-FABRIEKEN. May 10th. (Holland, June 20th, 1919.)

12,953. "Electric furnaces having resistance conduits." J. R. de ZUBIRIA Y SMITH. May 10th. (Spain, May 21st, 1919.)

12,954. "Electric furnaces having resistance conduits." J. R. DE ZUBIRIA Y SMITH. May 10th. (Spain, May 22nd, 1919.)

12,970. "Thermo-electric apparatus." W. H. WILSON. May 10th.

12,975. "Electrical mechanism and drive for gramophones, &c." R. H. TAYLOR. May 11th.

12,985. "Insulation for electrical conductors, &c." W. A. POWELL. May 11th.

12,986. "Electrical heating and cooking apparatus." W. H. MILLER. May 11th.

12,990. "Grips for electric lamp wire-holders." A. B. GOLDSMITH. May 11th.

12,999. "Electric lighting generator for cycles, &c." EXACT MANUFACTURING, LTD., and H. T. MOORES. May 11th.

13,026. "Magneto drive for tractors." J. W. THOMPSON. May 11th.

13,029. "Device for testing and adjusting ignition coils and sparking plugs." J. NAPIER. May 11th.

13,039. "Telephone systems." WESTERN ELECTRIC Co. May 11th. (United States, June 5th, 1919.)

13,042. "Means for producing alternating currents." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 11th.

13,053. "Electric switches, &c." T. WATSON. May 11th.

13,067. "Apparatus for extracting fuses or links on electric circuits." CALLENDER'S CABLE & CONSTRUCTION Co. and A. E. WILSON. May 11th.

13,070. "Electrolysers." J. F. WEBB. May 11th.

13,071. "Telephone systems." WESTERN ELECTRIC Co. May 11th. (United States, September 10th, 1919.)

13,077. "Sparking plugs, &c." C. W. V. HARRIS, C. JOHNSON, A. W. SMITH, T. E. TAYLOR and THE UNIVERSAL WELDING & ENGINEERING Co. May 11th.

13,086. "Thermionic valve transmitting circuits for wireless telegraphy and telephony." A. K. MACRORIE and G. SHEARING. May 11th.

13,154. "Telegraphic transmitter." SIEMENS & HALSKE AKT. GES. May 12th. (Germany, February 28th, 1919.)

13,159. "Dynamo-electric generators and motors." F. R. F. RAMSAY. May 12th.

13,160. "Radiogoniometers for wireless direction-finding, &c." G. M. WRIGHT. May 12th.

13,166. "Electrically operated cranes, hoists, &c." J. BENTLEY and W. H. SCOTT. May 12th.

13,171. "Electric time-controlled switches." L. J. LARSEN. May 12th.

13,182. "Electric switches." M. MANSELL. May 12th.

13,184. "Electric reading lamps." SOC. VALENDUCQ FRERES ET DUBOIS. May 12th. (France, May 30th, 1914.)

13,185. "Device for bonding and linking up steel tubing of electrical installations." C. FERGUSON and A. E. RYLAND. May 12th.

13,194. "Telegraph printing systems." AUTOMATIC TELEPHONE MANUFACTURING Co., H. H. HARRISON and S. R. SMITH. May 13th.

13,212. "Glass reflector for electric safety lamps." A. G. GULLIFORD. May 13th.

13,216. "Electric switches." S. E. & W. HALL. May 13th.

13,217. "Short-circuiting electrical devices." A. A. T. CRESER. May 13th.

13,239. "Signalling apparatus." D. M. & W. RITCHIE and J. SMITH. May 13th.

13,240. "Electro-plating by electrolytic thermic means." J. HESS and F. KIRSCHNER. May 13th. (Austria, October 10th, 1917.)

13,245. "Electric burglar alarm." L. J. & W. J. ALLBRIGHT. May 13th.

13,257. "Incandescent electric lamps." E. BERGERY. May 13th.

13,262. "Galvanic batteries." L. FULLER and FULLER'S UNITED ELECTRIC WORKS. May 13th.

13,272. "Apparatus for electro-deposition of metals." S. O. COWPER-COLES. May 13th.

13,275. "Self-induction coils for telephone circuits." SOC. INDUSTRIELLE DES TELEPHONES. May 13th. (France, May 22nd, 1919.)

13,276. "Electric heating devices for treatment of hair." F. KERKA and MARCEL'S PERMANENT, LTD. May 13th.

13,277/8/9/0. "Resistance switches for controlling intensity of electric currents." N. C. FRANCIS, A. E. QUENNELL and J. WATKINSON. May 13th.

13,281. "Receiving-apparatus for wireless telegraphy." C. T. HUGHES. May 13th.

13,298. "Sparking plugs." C. M. E. L. MONNIER. May 13th. (France, March 20th, 1919.)

13,300. "Thermo-electric apparatus." W. H. WILSON. May 13th.

13,309. "Electro-plating barrels, dipping baskets, &c." F. R. TUBBS. May 14th.

13,327. "Electrically-operated motor vehicles." HANSO-LLOYD WERKE. May 14th. (Germany, July 8th, 1919.)

13,330. "Means for connecting ends of electric, &c., cables." H. SCHOFIELD. May 14th.

13,340. "Wireless telegraph and telephone circuits." C. ROMER. May 14th.

13,352. "Thermionic devices." WESTERN ELECTRIC Co. May 14th. (United States, November 1st, 1916.)

13,359. "Electric switches." E. T. R. MURRAY and G. F. SHOTTER. May 14th. (United States, May 14th, 1919.)

13,379. "Electrical cells." EVER-READY Co. and C. S. MUMMERY. May 14th.

13,410. "Electric lanterns, &c." F. W. THORPE and VERITYS, LTD. May 15th.

13,417. "Electric switches." R. H. BAKER and C. W. PARSONS. May 15th.

13,418. "Portable electric lamps." F. BENTLEY. May 15th.

13,428. "Electric heater for perforating, &c., devices." A. B. CAMPBELL. May 15th.

13,431. "Magneto motor." D. SUCHOSTAWER. May 15th.

13,437. "Electric switches." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 15th.

13,438. "Multiple electric cables." H. BEVIS and PIRELLI GENERAL CABLE WORKS. May 15th.

13,455. "Devices for causing electricity to be supplied to instruments or circuits." A. R. ANGUS. May 15th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

14,567. SIGNALLING APPARATUS. British Thomson-Houston Co. (General Electric Co.). September 7th, 1918. (141,764.)

17,650. METHOD OF AND APPARATUS FOR ELECTROLYSING A SOLUTION OF NICKEL SALT. C. Heberlein. October 29th, 1918. (141,766.)

1919.

1,420. TELEPHONIC SYSTEMS. E. A. Graham. January 20th, 1919. (141,797.)

1,457. ELECTRIC SIGNALLING APPARATUS. P. Francois. January 20th, 1919. (141,803.)

1,552. ARC-RUPTURING DEVICES FOR ELECTRIC SWITCHES. T. Zweigbergk. January 21st, 1919. (141,808.)

1,571. ELECTRICALLY HEATED CRUCIBLES FOR USE IN TYPE-CASTING. W. J. Mellersh-Jackson (Cutler Hammer Manufacturing Co.). January 21st, 1919. (141,812.)

1,643. ELECTRIC MOTORS. British Thomson-Houston Co. and J. Martin. January 22nd, 1919. (141,814.)

1,668. ELECTRIC MOTOR CONTROL SYSTEMS. T. Zweigbergk. January 22nd, 1919. (141,816.)

1,747. MEANS OPERATED BY A RISE IN TEMPERATURE FOR CUTTING-OUT ELECTRICAL APPARATUS AND FOR EFFECTING MECHANICAL OPERATIONS. A. Dunhill. January 23rd, 1919. (141,820.)

2,054. ELECTRO-MAGNETIC VARIABLE-SPEED MECHANISM. E. Whiteley and R. Whiteley. January 28th, 1919. (141,823.)

2,810. GOVERNORS OR SPEED-REGULATORS FOR ELECTRIC MOTORS AND OTHER MACHINES. H. G. Turnell. February 5th, 1919. (141,830.)

4,836. ELECTRIC LOCK-OUT SWITCHES. A. West & Co., V. Breeze and R. P. Bossom. February 26th, 1919. (141,849.)

6,140. ELECTRICALLY-HEATED DOMESTIC OR LAUNDRY IRONS. W. Cross & Son and J. I. Kirby. March 12th, 1919. (141,862.)

6,987. SYSTEMS OF ELECTRIC POWER TRANSMISSION. British Thomson-Houston Co. (General Electric Co.). March 20th, 1919. (141,867.)

7,173. CONTROL OF ELECTRIC MOTORS. W. Brooke and E. M. Kerr. March 22nd, 1919. (141,870.)

7,478. MEANS FOR ENSURING IGNITION OF THE WORKING CHARGES AND PREVENTING CARBONISING OF THE SPARKING PLUGS OF INTERNAL-COMBUSTION ENGINES. Autoniters, Ltd., F. W. Hudlase and H. D. Smith. March 25th, 1919. (141,877.)

8,944. BRUSH-HOLDERS OF DYNAMO-ELECTRIC GENERATORS AND ELECTRIC MOTORS. Efandem Co., W. Owen and F. E. Cutler. April 9th, 1919. (141,892.)

9,003. ELECTRIC TIME-INDICATING APPARATUS. H. E. Warren. April 15th, 1918. (125,953.)

9,655. THERMIONIC RELAY VALVES. R. Whiddington. April 15th, 1919. (141,900.)

10,158. ELECTRICAL CONNECTOR FOR ENGINE SPARKING PLUGS AND OTHER PURPOSES. V. Bardin. January 16th, 1919. (137,803.)

10,770. METHODS OF AND APPARATUS FOR AUTOMATICALLY REMOVING GASES FROM ELECTRIC DISCHARGE TUBES AND THE LIKE. British Thomson-Houston Co. (General Electric Co.). April 30th, 1919. (141,913.)

13,494. OIL-IMMERSED WATER-COOLED ELECTRIC TRANSFORMERS. W. Lulofs & Ferranti, Ltd. May 28th, 1919. (141,946.)

14,790/1. MAGNETO-ELECTRIC MACHINES. C. Olivetti. June 11th, 1919. (14,554/5.)

17,276. TOOL FOR USE IN CLEANING SPARKING PLUGS. H. R. Wilks. July 10th, 1919. (141,975.)

18,632. STARTING MECHANISM FOR MAGNETOS OF INTERNAL-COMBUSTION ENGINES. W. Whiteley and F. Smith. July 28th, 1919. (141,986.)

23,108. ELECTRIC TERMINAL-PLATES, TERMINAL-SOCKETS, AND THE LIKE. A. Parkinson and F. & A. Parkinson. September 19th, 1919. (142,022.)

23,933. ELECTRIC SWITCHES. S. de P. Gorsky. November 9th, 1918. (135,167.)

24,719. ELECTRIC POCKET LAMPS. Galvanophoren Werke S. Szubert Kommandit Ges. October 10th, 1918. (133,699.)

25,285. ELECTRIC POCKET LAMPS. Cosmophos-Werke Akt. Ges. C. Boltshauser. October 15th, 1919. (142,031.)

27,250. WINDING MACHINE FOR THE MANUFACTURE OF HOLLOW-INSULATING CYLINDERS FOR ELECTRO-TECHNICAL PURPOSES. E. Haefeley et Cie. September 2nd, 1919. (142,039.)

28,160. MEASURED SERVICE TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. February 12th, 1919. (138,857.)

31,164. IGNITION SYSTEMS. Dayton Engineering Laboratories Co. February 22nd, 1917. (Divided application on 31,177/18.). (136,586.)